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ABSTRACT

Learning activity packages are presented for instruction in tractor mechanics. The packages deal with the duties involved in maintaining the fuel system. The following fourteen learning activity packages are included: servicing fuel and air filters, servicing fuel tanks and lines, adjusting a carburetor, servicing a carburetor, servicing the intake manifold, servicing the governor, servicing the fuel pump, servicing the diesel fuel filters, servicing the diesel transfer pump, servicing a diesel injection pump, servicing a diesel fuel injector, bleeding the diesel fuel system, timing a fuel injection pump, and servicing a turbocharger. Typically the packages' format contains introduction, directions, objectives, learning activities, tools and equipment needed, supplies and materials needed, safety instructions, student self-check, check-out activities, and the instructor's final checklist. The packages are illustrated. (CSS)

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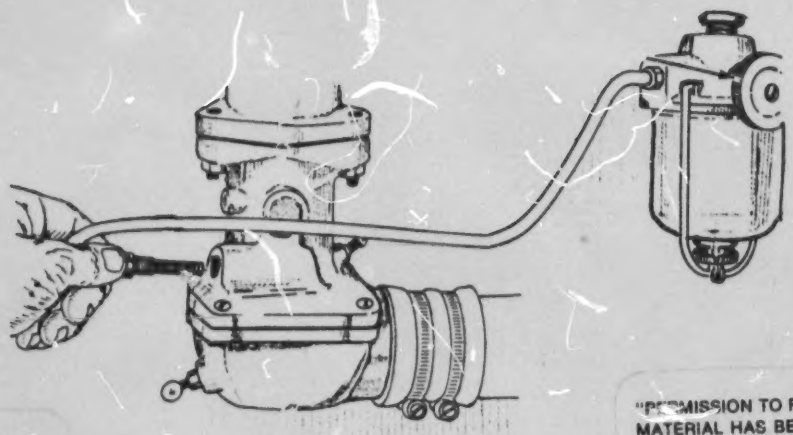
TRACTOR MECHANICS

MAINTAINING AND SERVICING THE FUEL SYSTEM

LEARNING ACTIVITY PACKAGES 20 - 33



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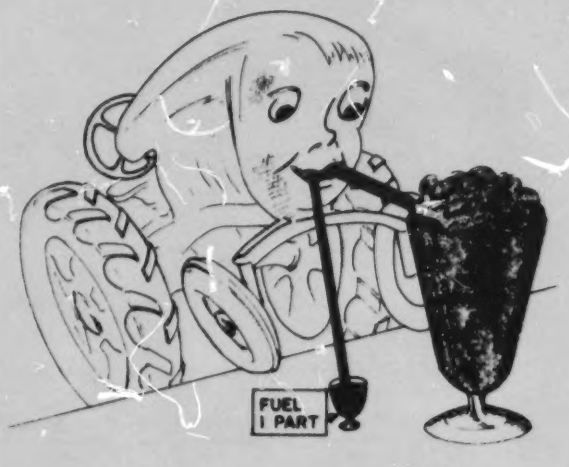
TRACTOR MECHANICS

DUTY: MAINTAINING AND SERVICING THE FUEL SYSTEM

Learning Activity Package Number	Objective Number	Learning Activity Package Title
20	12-80	Servicing Fuel and Air Filters
21	84	Servicing Fuel Tanks and Lines
22	77-78	Adjusting a Carburetor
23	76-79-81	Servicing a Carburetor
24	125	Servicing the Intake Manifold
25	14-15	Servicing the Governor
26	82-83	Servicing the Fuel Pump
27	86	Servicing the Diesel Fuel Filters
28	89	Servicing the Diesel Transfer Pump
29	88	Servicing a Diesel Injection Pump
30	87	Servicing a Diesel Fuel Injector
31	55	Bleeding the Diesel Fuel System
32	91	Timing a Fuel Injection Pump
33	90	Servicing a Turbocharger

Learning Activity Package Number 20

Objectives 12-80



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SERVICING FUEL AND AIR FILTERS

Tractor Mechanics

INTRODUCTION

All modern tractors have some way of filtering dirt from the fuel and air going to the engine. These filters must be serviced at the times recommended by the manufacturer in order to prevent carburetor troubles and unnecessary engine wear. Many tractors will come into the shop needing this service. In this learning activity package you will learn to properly service an oil-bath air cleaner and clean a sediment bowl.

DIRECTIONS

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 6 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVES

1. Given a tractor equipped with oil-bath air cleaner, manufacturer's service manual, necessary tools and supplies, service an oil-bath air cleaner.

2. Given a clean rag and a tractor with a sediment bowl, clean the sediment bowl. Upon visual inspection, the bowl will be free of dirt and foreign matter and there will be no leak around the gasket.

LEARNING ACTIVITIES

1 READ *Tractor Operation and Daily Care* (AAVIM), pp. 3-7, 13.

(or) _____

2 READ *Fundamentals of Machine Operation: Preventive Maintenance* (Deere & Company), Fig. 23, p.43.

(or) _____

3 CHECK YOUR KNOWLEDGE of the parts of fuel and air filters by taking Student Self-Check, IDENTIFYING THE PARTS OF FUEL AND AIR FILTERS.

4 READ INSTRUCTIONS, SERVICING FUEL AND AIR FILTERS.

(or) _____

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

6 PRACTICE removing and replacing an oil cup on the shop tractor

7 READ the manufacturer's service manual for air filter, oil type, and viscosity requirements.

(or) _____

8 PRACTICE removing and replacing the sediment bowl on the shop tractor.

9 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 6.

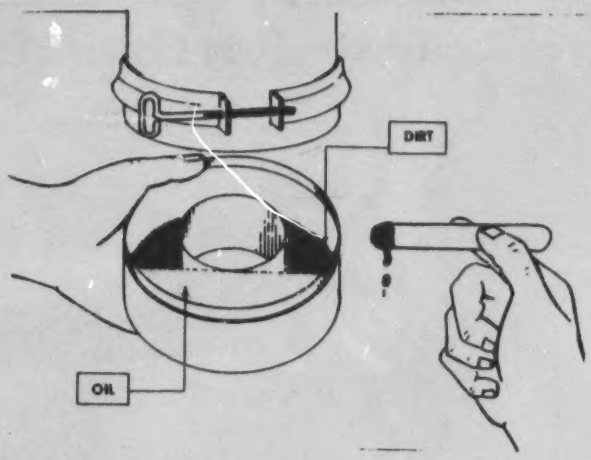

Figure 1. Use clean stick to measure sediment depth in outer chamber of cup.

Courtesy of the American Association for Vocational Instructional Materials

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set

MATERIALS AND SUPPLIES NEEDED

1. Operator's Manual
2. Oil - SAE No. 10
3. Cleaning Solvent
4. Gasket For Fuel Bowl

SAFETY

Do not use gasoline for cleaning air cleaner; use kerosene or diesel fuel.

INSTRUCTIONS

SERVICING FUEL AND AIR FILTERS

In servicing the sediment bowl and air filter, the following procedures should be used:

AIR FILTER

1. Loosen oil cup and remove from filter.
2. Check depth of sediment deposit in outer chamber.
3. Discard dirty oil. Scrape and wash inner and outer cups with clean kerosene, mineral sprits, or diesel fuel. (CAUTION: DO NOT USE GASOLINE)
4. Check air-intake pipe for dirt accumulation. Clean if needed.
5. Refill cup with clean oil of recommended viscosity to oil level mark.
6. Replace oil cup and screen tray; tighten clamp.
7. Check air duct between cleaner and carburetor for holes or loose clamp connections. Tighten clamps or replace duct as needed.
8. Check air-inlet screen or precleaner and remove any trash that is found.

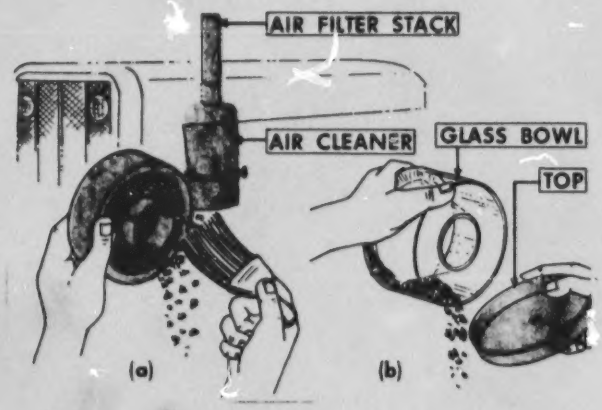

Figure 2. (a) Clean screened air intake with stiff brush. (b) Clean pre-cleaner by removing bowl and emptying contents.

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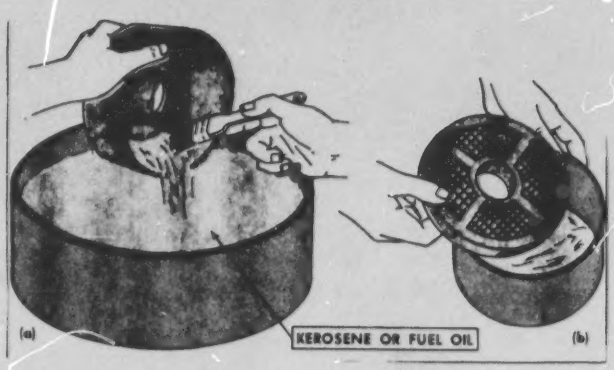

Figure 3. (a) Thoroughly clean oil cup with diesel fuel, mineral spirits or kerosene. (b) Some filters are equipped with a screen tray. Remove dirt particles from bottom of screen at time cup is cleaned.

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FUEL FILTER (Sediment Bowl)

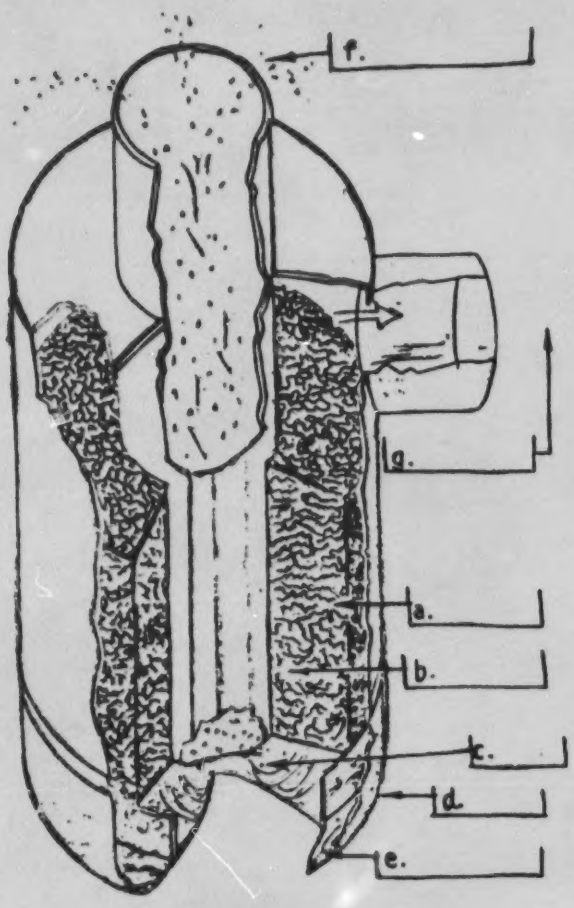
1. Turn off fuel at fuel shut-off valve.
2. Loosen jam nut on wire bail at the bottom of the sediment bowl.
3. Remove bowl gasket and screen (if there is one).
4. Carefully wipe the sediment bowl and screen with clean rag.
5. Open shut-off valve slightly, allowing a small amount of fuel to flush out the top part of the sediment bowl housing. Catch overflow in a suitable container.
6. Inspect gasket for cuts or damage and replace if necessary. Reinstall screen, gasket, and bowl. Tighten bowl with wire bail and jam nut.
7. Turn on fuel and check for leaks.
8. Dispose of waste fuel and rags safely.

STUDENT SELF-CHECK

IDENTIFYING PARTS OF FUEL AND AIR FILTERS

DO NOT WRITE ON THIS PAGE!

1. Label the following drawing of an oil-bath air filter:



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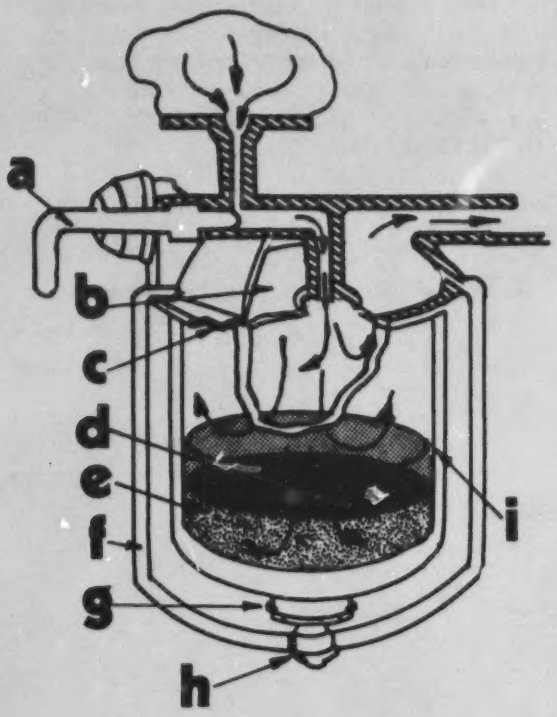
2. Identify and label the following parts of the gasoline fuel filter (sediment bowl):



CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING FUEL AND AIR FILTERS.

Service the oil-bath air cleaner on the designated tractor.

Clean the sediment bowl on the designated tractor.

Compare your answers with the correct responses in the answer box. Review any incorrect answers before going on to the next Learning Activity.

CORRECT RESPONSES

1. a) filtering element b) oil spray c) oil d) oil cup e) trapped dirt f) dirt particles g) clean air

2. a) shut-off valve b) filter screen c) gasket d) water e) dirt f) bail g) nut h) bail-screw i) filter bowl

LAP TM-20

Student _____

Date _____

SERVICING FUEL AND AIR FILTERS

Instructor's Final Checklist

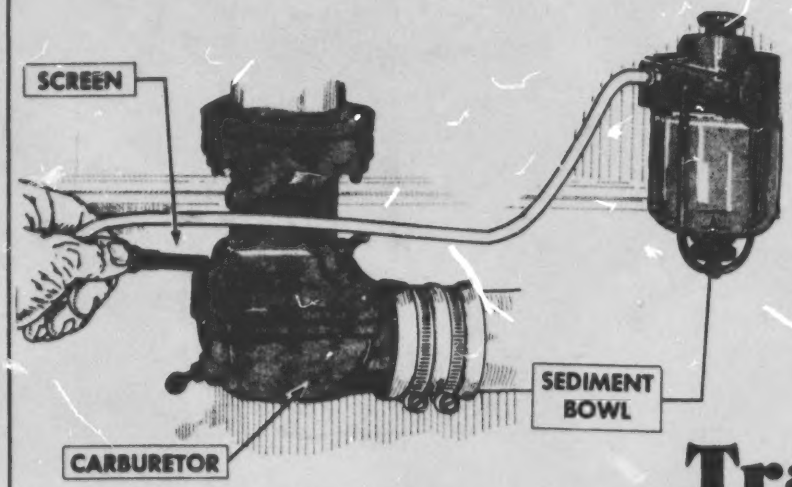
Check the student's performance in the following elements of servicing fuel and air filters.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In servicing air filters, the student:				
a. loosened and removed the oil cup from filter	[ ]	[ ]	[ ]	[ ]
b. checked depth of sediment deposit in outer chamber	[ ]	[ ]	[ ]	[ ]
c. cleaned oil cup	[ ]	[ ]	[ ]	[ ]
d. checked and cleaned air intake pipe	[ ]	[ ]	[ ]	[ ]
e. refilled oil cup to oil fill mark	[ ]	[ ]	[ ]	[ ]
f. used correct oil	[ ]	[ ]	[ ]	[ ]
g. replaced oil cup and tightened clamp	[ ]	[ ]	[ ]	[ ]
h. checked air duct between cleaner and carburetor for holes or loose connections; tightened or replaced as needed	[ ]	[ ]	[ ]	[ ]
i. removed debris from inlet screen or precleaner	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 21



Courtesy of the American Association for Vocational Instructional Materials

Servicing Fuel Tanks and Lines

Tractor Mechanics

Objective 84

INTRODUCTION

Fuel tanks and fuel lines are normally serviced only when they function improperly. This is usually due to rust, corrosion, dirt, or mechanical damage. The most common problem is dirt which results from contaminated fuel. When the carburetor must be cleaned, the fuel tank and lines should be checked to see if they need service also. In this learning activity package you will learn how to remove, inspect, clean, and reinstall fuel tanks and lines.

DIRECTIONS

Before you start to work on this learning activity package, be sure you have completed Learning Activity Package 20, SERVICING THE FUEL AND AIR FILTERS.

If you have completed this Learning Activity Package, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given assorted wrenches and clean rags, service a fuel tank and fuel lines. There will be no dirt in the sediment bowl and no leaks in the fuel valve, sediment bowl, or fuel line connection.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), pp. 3-2 through 3-4.

(or) _____

2 READ INSTRUCTIONS, SERVICING FUEL TANKS AND LINES.

(or) _____

3 CHECK YOUR KNOWLEDGE of the fuel system by taking Student Self-Check, UNDERSTANDING THE FUEL SYSTEM.

4 READ the manufacturer's service manual section on fuel tanks and lines in the designated tractor.

(or) _____

5 PRACTICE servicing the fuel tanks and lines on the designated tractor. Follow the procedure outlined on Instruction Sheet and the manufacturer's service manual.

6 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 4.

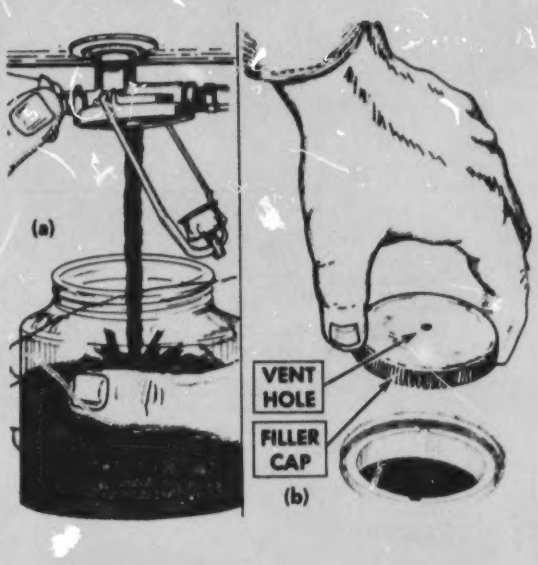


Figure 1. (a) Be sure to catch wasted fuel in a container. (b) If fuel flow is slow, the vent hole may be plugged in the filler cap. Clean the cap in the same solution used for cleaning the filter and bowl.

Courtesy of the American Association for Vocational Instructional Materials

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Air Compressor

MATERIALS AND SUPPLIES NEEDED

1. Container for Wasted Fuel
2. Two Quarts Fuel for Cleaning Tank
3. Sediment Bulb Gasket
4. Sediment Bulb Screen
5. Clean Rags
6. Pipe Joint Cement

SAFETY

1. Do Not Smoke
2. Catch All Wasted Fuel
3. Clean All Spills

INSTRUCTIONS

SERVICING FUEL TANKS AND LINES

In servicing the fuel tank and lines, the following procedure should be used:

CAUTION: Handle and store fuel with care.

1. Visually inspect the fuel system to determine need for service.
2. Shut off fuel, disconnect outlet line, and drain all the fuel from the fuel tank.
3. Remove fuel shut-off valve from fuel tank.

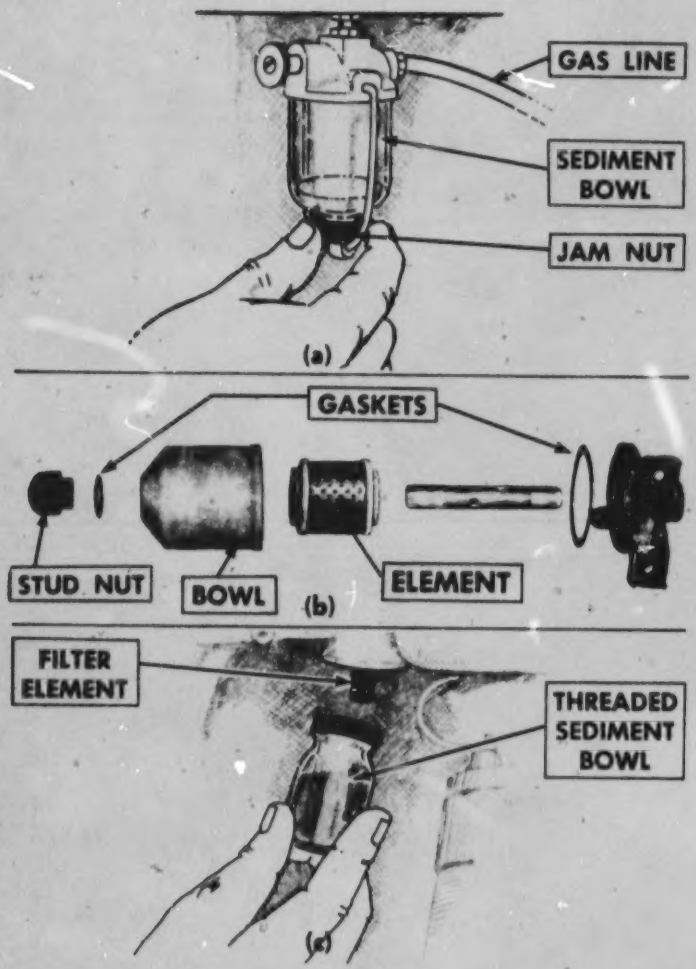


Figure 2. Sediment bowls and fuel filters may be held in place by:(a) a jam nut, (b) a stud nut or (c) the bowl may be threaded and screwed into the base.

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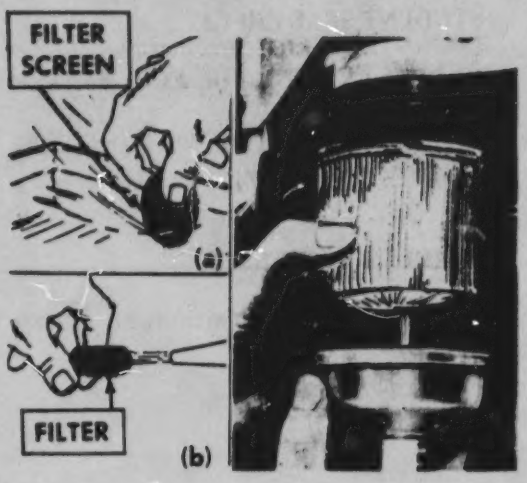


Figure 3. (a) To clean a screen filter swish it back and forth in clean kerosene or diesel fuel. (b) To clean a disc filter, blow air through end of disc assembly to finish removing any dirt particles or liquid. Don't direct air against side of filter, that forces dirt particles and liquid back into center of unit. (c) Replace the throw-away type filter with a new one of the same type.

Courtesy of the American Association for Vocational Instructional Materials

4. Pour a quart of clean fuel into the tank; agitate the tank; and allow this fuel to run out of the tank. Repeat this procedure. Discard the fuel used for cleaning. (Note: Tanks with standpipes must be removed and inverted.)
5. Clean fuel shut-off valve and reinstall into tank.
6. Disconnect fuel line from the carburetor. Remove sediment bowl and screen.
7. Pour a small smount of fuel into the tank and allow it to run through the sediment bowl body.
8. Clean sediment bowl, screen and replace.
9. Once again, pour a small amount of fuel into the fuel tank and allow to run into the sediment bowl through the fuel line to the disconnected point at the carburetor. (Note: Some carburetors will have a screen at the point where the fuel line connects to the carburetor. Simply loosen the fitting into the carburetor and remove it. The screen, which will be attached to this fitting,should be cleaned thoroughly.
10. Reinstall screen in carburetor; connect fuel line; fill fuel tank with fuel. Check for leaks.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
UNDERSTANDING THE FUEL SYSTEM

Draw a diagram of the fuel flow pattern for the designated tractor.

CORRECT RESPONSES

Check this with the manufacturer's service manual.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING FUEL TANKS AND LINES.

Service the fuel tank and fuel lines on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP TM–21

Student _____

Date _____

SERVICING FUEL TANKS AND LINES

Instructor's Final Checklist

Check the student's performance in the following elements of servicing fuel tanks and lines.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In servicing the fuel tanks and fuel lines, the student:				
a. visually inspected the system for problems	[ ]	[ ]	[ ]	[ ]
b. drained fuel from the tank	[ ]	[ ]	[ ]	[ ]
c. thoroughly cleaned the fuel tank	[ ]	[ ]	[ ]	[ ]
d. removed, cleaned, and reinstalled fuel shut-off valve	[ ]	[ ]	[ ]	[ ]
e. cleaned sediment bowl and screen	[ ]	[ ]	[ ]	[ ]
f. flushed fuel lines	[ ]	[ ]	[ ]	[ ]
g. cleaned carburetor fuel screen	[ ]	[ ]	[ ]	[ ]
h. checked for leaks	[ ]	[ ]	[ ]	[ ]
2. The fuel tanks, fuel lines, and sediment bowl did not leak	[ ]	[ ]	[ ]	[ ]
3. When installing a carburetor kit, the student:				
a. turned off the fuel	[ ]	[ ]	[ ]	[ ]
b. removed the carburetor	[ ]	[ ]	[ ]	[ ]
c. separated the top and bottom of the carburetor	[ ]	[ ]	[ ]	[ ]
d. removed the float, needle, seat, and gasket	[ ]	[ ]	[ ]	[ ]

DO NOT WRITE ON THIS PAGE

LAP TM–21

Student _____

Date _____

SERVICING FUEL TANKS AND LINES

Instructor's Final Checklist (Cont'd)

Check the student's performance in the following elements of servicing fuel tanks and lines.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
e.	placed both halves of the carburetor body in cleaning solution for an adequate amount of time	[ ]	[ ]	[ ]	[ ]
f.	washed cleaning solution from the carburetor with very hot water	[ ]	[ ]	[ ]	[ ]
g.	blew all areas of the carburetor clean and dry with compressed air	[ ]	[ ]	[ ]	[ ]
h.	installed all new parts from kit	[ ]	[ ]	[ ]	[ ]
i.	checked and adjusted float height	[ ]	[ ]	[ ]	[ ]
j.	assembled the carburetor	[ ]	[ ]	[ ]	[ ]
k.	installed the carburetor on the engine	[ ]	[ ]	[ ]	[ ]
l.	made idle adjustments with the engine at operating temperature	[ ]	[ ]	[ ]	[ ]
m.	made load mixture adjustment with a dynamometer	[ ]	[ ]	[ ]	[ ]
n.	completed installation in less than 1 1/2 hours	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 22

Objectives 77-78

Courtesy of the John Deere and Company

Adjusting a Carburetor

Tractor Mechanics

INTRODUCTION

On any tractor, the carburetor must be adjusted correctly for the engine to run smoothly and economically. Most carburetors will have screws to adjust the amount of air and fuel allowed to pass through the intake manifold and valves into the cylinders. The air and fuel must be in correct proportions for good combustion. Another important adjustment is the idle speed screw. This determines how fast the engine will idle. Correct idle speed is needed to prevent the engine from dying when power is disengaged. In this learning activity package you will learn to adjust a tractor carburetor.

DIRECTIONS

Before you start work on this learning activity package, be sure you have completed Learning Activity Package TM-20, SERVICING FUEL AND AIR FILTERS.

If you have completed this Learning Activity Package, read the objectives below. If you feel you are already able to perform these tasks, read the Check-Out Activities on page 6 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVES

1. Given a screwdriver, adjust the carburetor idle air/fuel mixture. When adjusted, the engine will run smoothly and no black smoke will come from the exhaust.

2. Given the manufacturer's service manual and a screwdriver, adjust the engine idle speed. Check engine tachometer and compare with recommended RPM in the service manual. If there is no engine tachometer, the tractor should move at idle speed when in first and second gear.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), pp. 3-17 to 3-18.

(or) _____

2 CHECK YOUR KNOWLEDGE by taking Student Self Check, ADJUSTING A CARBURETOR.

(or) _____

3 READ INSTRUCTIONS, ADJUSTING IDLE MIXTURE AND IDLE SPEED.

(or) _____

4 READ the section on carburetor adjustments in the manufacturer's service manual for the designated tractor or I & T Shop Manual for Tractors.

(or) _____

5 RECORD carburetor adjustment specifications from the manufacturer's service manual.

(or) _____

6 PRACTICE adjusting idle speed and mixture on a shop tractor or lab engine. Follow the procedure outlined in Instructions and the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 6.

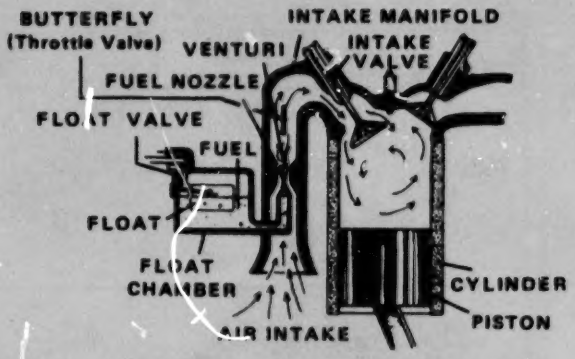


Figure 1. Operating principle of a carburetor. Air is drawn through the carburetor air intake and past the fuel nozzle as the piston descends in the cylinder. The restricted section (venturi) causes air speed to increase and pick up fuel from the fuel nozzle. A supply of fuel is kept available at a constant level by means of the float-control valve in the float chamber.

Courtesy of the American Association for Vocational Instructional Materials

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Manufacturer's Service Manual and/or I & T Shop Manual
3. Tachometer (for tractors without one)
4. Dynamometer, if available, should be used for final check on fuel consumption, horsepower, etc.

MATERIALS AND SUPPLIES NEEDED

1. Cleaning supplies (rags, solvent, brush and air hose)

SAFETY

1. Avoid injury—Do not smoke or allow any flame near the area.
2. Do not allow gasoline to spill onto any hot surface, such as: a hot manifold, exhaust pipe, etc.
3. Clean up gasoline spills from under tractor.
4. Do not try to adjust carburetor while tractor is in motion. This may cause serious injury to yourself and others nearby.

INSTRUCTIONS

ADJUSTING IDLE MIXTURE AND IDLE SPEED

In adjusting the idle mixture, the following procedure should be used:

1. Check engine air cleaner and make sure that the engine can get clean, unrestricted air flow.
2. Start engine and let warm up to normal operating temperature.
3. Check and/or set idle speed. (See below.)
4. Turn idle adjustment screw in until the engine begins to run irregularly. Note position of screw head.
5. Turn the screw out until engine smooths out and once again runs irregularly. Note the position of screw head.
6. Turn the screw half way between these two settings.
7. Advance the throttle two or three times and then let the engine return to idle speed.
8. Check setting with tachometer.

NOTE: If the engine continues to run smoothly and there is no black smoke from the exhaust, the adjustment is correct. Otherwise, further idle-speed screw adjustment is indicated.

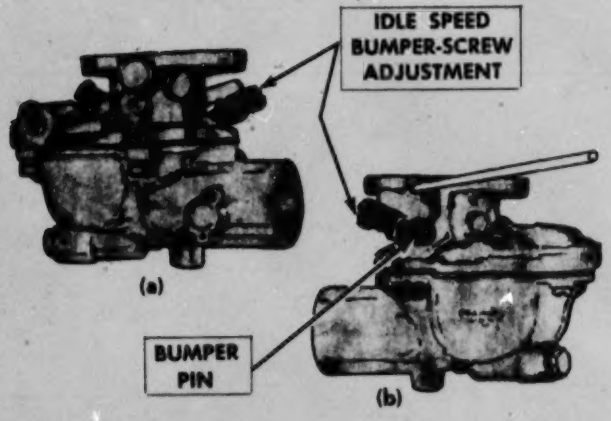


Figure 2. (a) The idling-speed or bumper-screw adjustment is commonly located on the engine side of the carburetor. (b) If viewed from the engine side, you would see that the bumper screw works against a pin. The screw adjustment determines how completely the throttle valve closes and how fast the engine idles.

Courtesy of the American Association for Vocational Instructional Materials

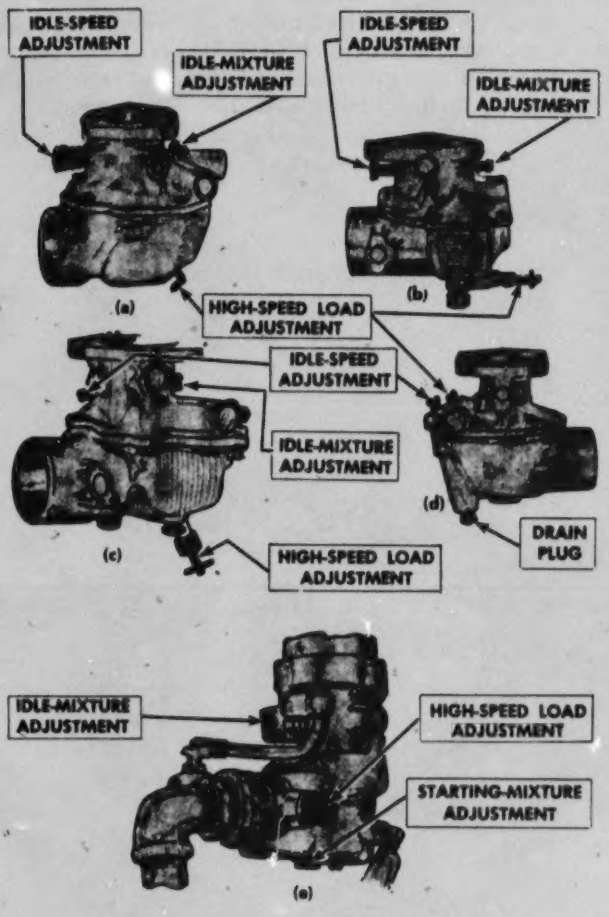


Figure 3. (a, b, c, and d) Carburetor adjustment screws as located on carburetor designs commonly found on tractors that burn liquid fuel. (e) Carburetor adjustments on an LP-Gas carburetor.

Courtesy of the American Association for Vocational Instructional Materials

In adjusting idle speed, the following procedure should be used:

1. Check air cleaner for dirt and clogged passages. Make sure air flow to the carburetor is not restricted.

2. Start engine and bring to normal operating temperature.

3. Turn engine idle screw in or out to increase or decrease engine speed.

4. Check engine speed with tachometer.

NOTE: Most tractors should idle at from 500-700 RPM. The idle speed can be adjusted by looking at the engine tachometer to check engine speed or by using a tune-up tachometer. If no engine tachometer exists, turn the idle screw until the engine runs smoothly, but not so slow that the engine dies when put into gear or when moving at idle speed.

Figure 5. Dynamometer Test

Courtesy of John Deere and Company

Idling System for Updraft Carburetors

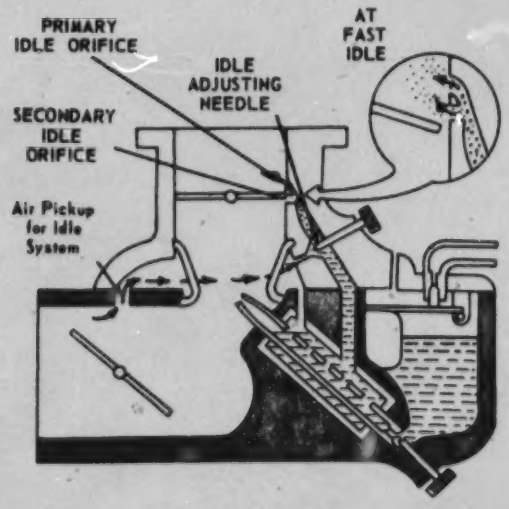


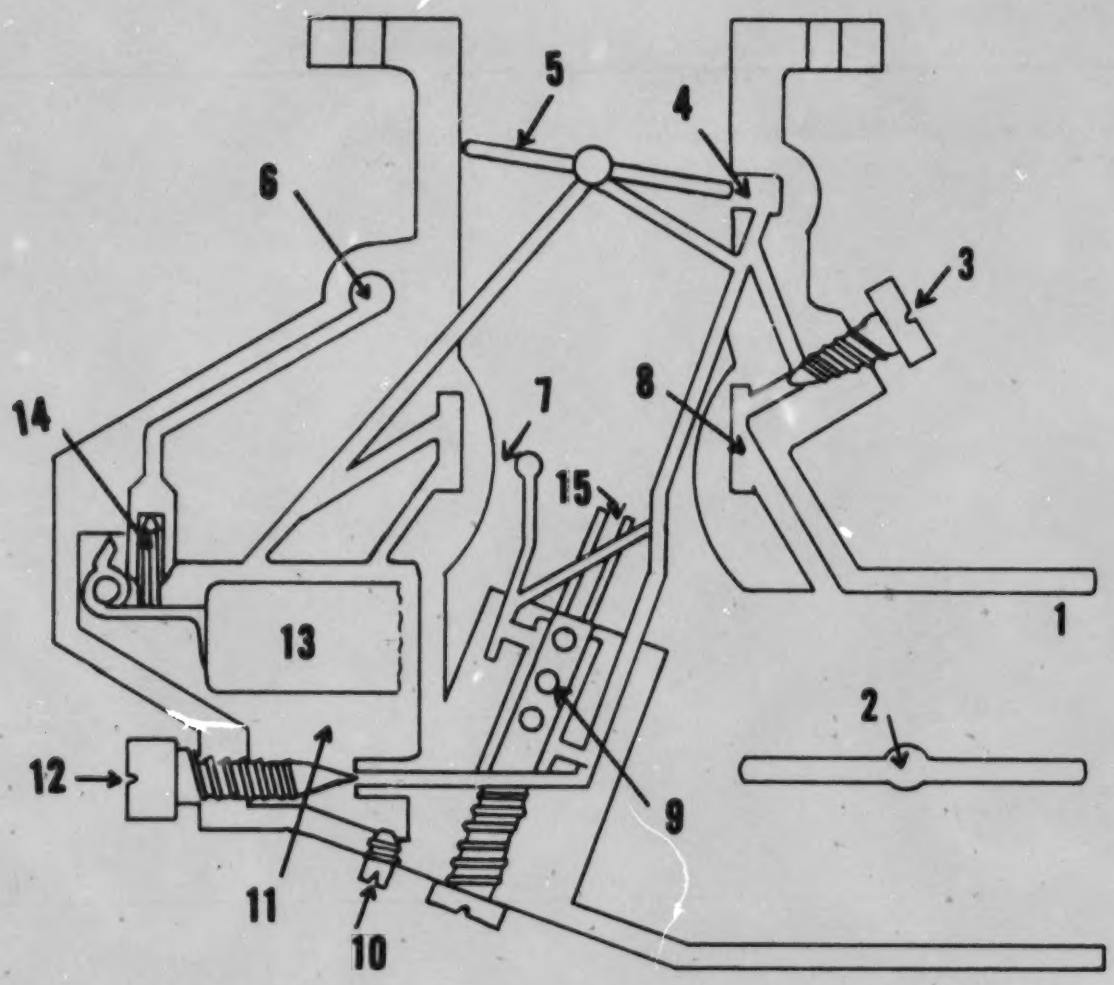
Figure 4. Idling System for Updraft Carburetor
In the updraft carburetor shown in Figure 4, air for the idle system goes around the venturi and enters the fuel system through a drilled passage (see arrows). The idle adjusting needle regulates the amount of air used.

Courtesy of John Deere and Company

21

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
LABELING CARBURETOR PARTS

Label the parts of the following diagram:



Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. air horn (intake)
2. choke
3. idle adjusting needle
4. idle orifice
5. throttle
6. fuel intake
7. venturi
8. idle circuit
9. accelerator adjusting well
10. bowl drain plug
11. float bowl
12. full load adjusting needle
13. float
14. needle valve
15. main jet

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, ADJUSTING A CARBURETOR.

Adjust the carburetor idle air/fuel mixture.

Adjust the engine idle speed on the designated tractor.

23

LAP TM 22

Student _____

Date _____

ADJUSTING A CARBURETOR

Instructor's Final Checklist

Check the student's performance in the following elements of adjusting a carburetor.

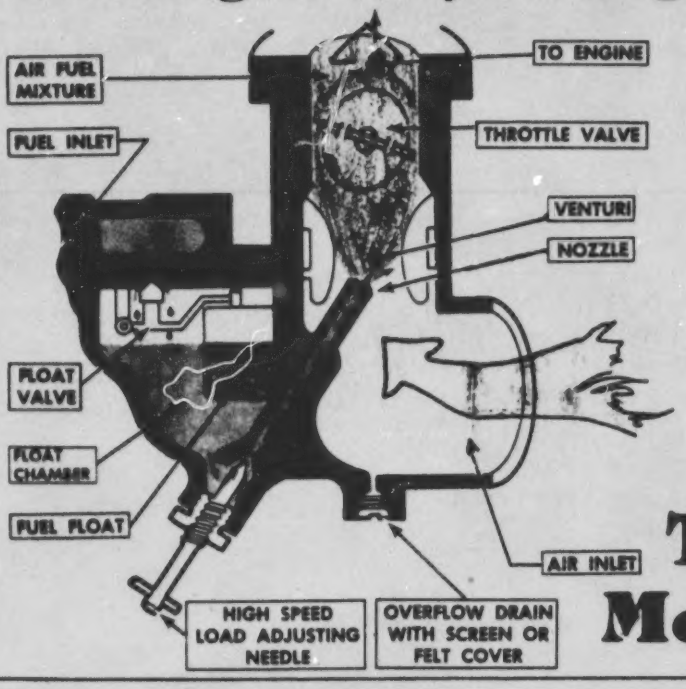
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In adjusting the idle mixture, the student:				
a. checked and cleaned the air intake	[ ]	[ ]	[ ]	[ ]
b. brought engine to operating temperature	[ ]	[ ]	[ ]	[ ]
c. checked and set idle speed	[ ]	[ ]	[ ]	[ ]
d. adjusted idle mixture (lean to rich to balanced)	[ ]	[ ]	[ ]	[ ]
e. advanced throttle and returned to idle	[ ]	[ ]	[ ]	[ ]
f. checked speed with tachometer	[ ]	[ ]	[ ]	[ ]
2. In adjusting the idle speed, the student:				
a. checked and cleaned the air intake	[ ]	[ ]	[ ]	[ ]
b. brought engine to operating temperature	[ ]	[ ]	[ ]	[ ]
c. turned idle speed screw to obtain correct idle speed	[ ]	[ ]	[ ]	[ ]
d. rechecked speed with tachometer	[ ]	[ ]	[ ]	[ ]
3. The engine idled at manufacturer's recommended speed	[ ]	[ ]	[ ]	[ ]
4. The engine idled smoothly with no excess smoking	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 23

Objectives 76-79-81



Servicing a Carburetor

Tractor Mechanics

Courtesy of the American Association for Vocational Instructional Materials

INTRODUCTION

Most gasoline engines have a carburetor. The purpose of the carburetor is to mix the right proportions of air and fuel and to deliver this mixture to the engine as it is needed. Any time the carburetor fails to provide the right amount of the correct mixture, some carburetor service is needed. In this learning activity package you will learn how to clean and rebuild a carburetor and to adjust the float level.

DIRECTIONS

Before you begin this learning activity package, be sure you have completed Learning Activity Package 22, ADJUSTING A CARBURETOR.

If you have completed this Learning Activity Package, read the objectives below. If you feel you are already able to perform these tasks, read the Check-Out Activities on page 7 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVES

1. Given end wrenches, screwdrivers, clean rags, solvent, safety glasses or face shield, and an air hose, clean the carburetor on a gasoline-powered tractor. Upon inspection the inside of the carburetor will be clean. No jets or holes will be plugged and the engine will operate properly.

2. Given the manufacturer's service manual, end wrenches, screwdriver, pliers and a ruler, adjust a carburetor float. The ruler, and the engine will run smoothly after the carburetor has been reassembled and installed. After the engine has run and been turned off, the gasoline will not overflow in the carburetor bowl.

3. Given an assorted set of end wrenches, a service manual, screwdrivers, needle-nose pliers, carburetor cleaner, and a dynamometer, install a carburetor repair kit on the designated tractor. There should be no fuel leaks in the carburetor, stopped,idling, or under load. The engine should run at service manual specifications. The actual work time should not exceed 1-1/2 hours, excluding time parts are in cleaning solution.

LEARNING ACTIVITIES

1 READ *Fundamentals of Machine Operation: Preventive Maintenance* (Deere & Company), pp. 39-43.

(or)_____

2 READ *Fundamentals of Service: Engines* (Deere & Company), pp. 3-16 through 3-17.

(or)_____

3 VIEW the slide-tape presentation TM-23, CARBURETOR OVERHAUL.

(or)_____

4 READ INSTRUCTIONS, UNDERSTANDING THE CARBURETOR, and SERVICING A CARBURETOR.

(or)

5 CHECK YOUR KNOWLEDGE of carburetors by taking Student Self-Check, UNDERSTANDING CARBURETORS.

6 PRACTICE dismantling and reassembling a laboratory carburetor. Follow the procedure outlined in Learning Activity 4 and the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 7.

TOOLS AND EQUIPMENT NEEDED

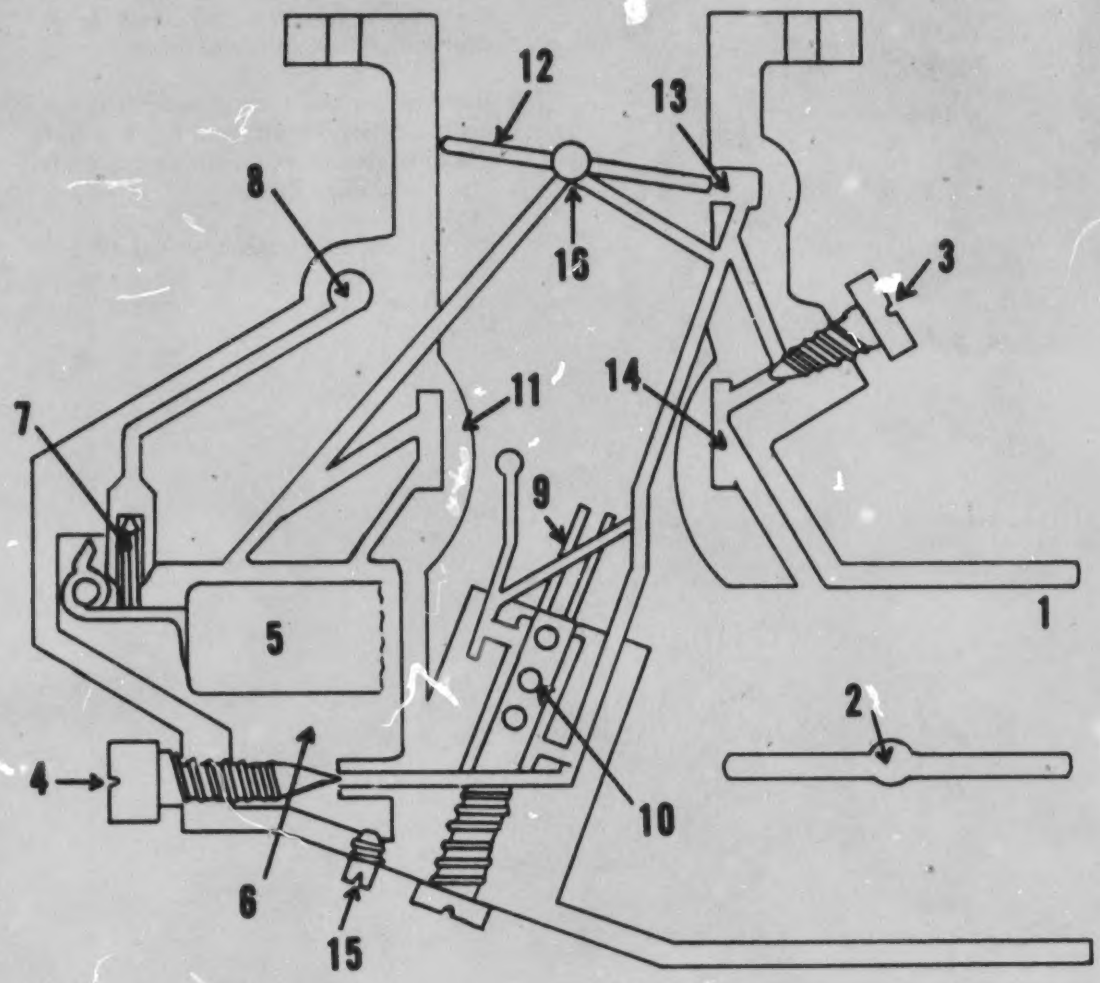
1. Mechanic's Tool Set
2. Air Hose
3. Safety Glasses or Face Shield
4. Manufacturer's Service Manual and I & T Shop Manual
5. Mechanics Ruler for Adjustment
6. Dynamometer

SAFETY

1. Use Safety Glasses or Face Shield
2. Follow Directions When Using Carburetor Cleaner
3. Do Not Place Hand In Cleaning Solution Do Not Handle Parts Before They Are Washed and Dried With Air
4. Do Not Place Hand In Eyes or Mouth

INSTRUCTIONS

A. UNDERSTANDING THE CARBURETOR



1-Primary Air Inlet
2-Choke Valve
3-Idle Adjusting Screw
4-Main Adjusting Screw
5-Float
6-Float Chamber
7-Float Valve
8-Fuel Inlet
9-Main Jet
10-Main Air Bleeds
11-Venturi
12-Throttle Valve
13-Idle Jet
14-Air Balance Chamber
15-Drain Plug
16-Economizer

Source: Individual Study Guide on Carburetion (Ohio Agricultural Education Curriculum Material Service), p. 79.

Figure 1 – Typical carburetor kit with new gaskets, bushings, and jets.

5. Take air hose and blow remaining water from the parts. Be sure to blow into all holes and corners.

6. Remove each jet individually and replace with a new one. Remove throttle shaft and bushings and replace with new ones. Follow the same procedure for the remaining new parts. After all new parts have been installed and float height adjusted, reassemble carburetor.

7. With carburetor reassembled, install on engine. Start engine and let run until reaching normal operating temperature. Make final idle adjustment.

8. To set load adjustment, put tractor on dynamometer and set load screw to specifications.

B. INSTALLING A CARBURETOR KIT

When installing a carburetor kit, the following procedure should be used:

1. Turn off fuel supply and remove carburetor from engine.

2. Remove screws from top of carburetor; remove carburetor float, needle, seat, and gasket from top half of carburetor.

3. Place the top and bottom halves of the carburetor into a can of carburetor cleaning solution. Let stand for at least four hours.

4. Remove carburetor from cleaning solution and wash thoroughly with very hot water.

C. CLEANING A CARBURETOR

When cleaning a carburetor, the following procedure should be used:

1. Shut off fuel valve under fuel tank and remove carburetor from engine.
2. Remove screws from top of carburetor.
3. With a clean rag, wipe all dirt and sludge from the carburetor top, float, needle valve and seat, inside and out. Put on safety glasses and with an air hose blow dirt from top half, including jets and crevices.
4. Reinstall needle valve, seat and float assembly. Check float adjustment.
5. Clean the bottom half of the carburetor of gasoline, water, rust, etc., scraping with a knife if needed. Blow out with air hose making sure no jets, holes, tubes, etc., are plugged. (Note: If jets cannot be cleaned with air hose, jet can be removed with screwdriver for further cleaning. Use care to avoid enlarging jets or passages.)
6. Reassemble, replacing gaskets if needed.
7. Install carburetor; start engine and adjust.

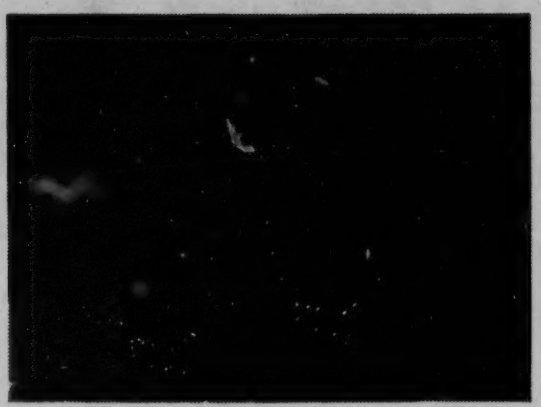


Figure 2 – Carburetor parts in wire basket to be cleaned in a non-flamable carburetor cleaner.

D. ADJUSTING A CARBURETOR

When adjusting a carburetor float, the following procedure should be used:

1. Shut off fuel valve under fuel tank and remove carburetor from tractor.

2. Remove screws from top of carburetor and lift top half of carburetor from carburetor bowl.

3. Lay top half of carburetor upside down in a vise or on the workbench. (At this point, the float will be in the top side of the carburetor.)

4. Remove pin holding float to the carburetor. Visually inspect the float for holes. Shake the float to see if there is any gasoline inside the float. (If gasoline is inside float, discard it and replace with a new one.)

5. Reinstall the float, and with a ruler measure the distance from the carburetor top to the top of the float. Check service manual for correct height and adjust distance accordingly. (If carburetor is being rebuilt, the rebuilding kit often comes with a preset float gauge.)

6. Bend the float shaft up or down to reach desired height, being careful not to put excessive pressure on the needle valve.

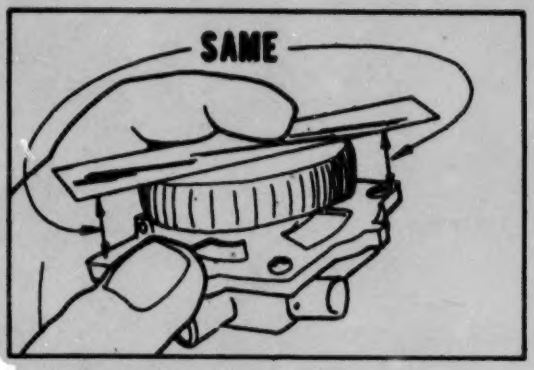


Figure 3 – Measure distance from the carburetor top to the top of the float. Adjust according to service manual specifications.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
UNDERSTANDING CARBURETORS

Answer the following:

1. What purpose does a carburetor serve?

2. What does the float do?

3. What should you do if there is fuel inside the float?

4. List six things that affect carburetion:
   a.
   b.
   c.
   d.
   e.
   f.

Compare your answers with the correct responses in the answer box. Review any incorrect answers before going on to the next Learning Activity.

CORRECT RESPONSES

1. It mixes air and fuel in correct proportions and delivers the right amount of mixture to the engine.
2. Control fuel level in the carburetor
3. Replace it
4. a) fuel supply
   b) air cleaner
   c) carburetor
   d) governor
   e) compression
   f) ignition

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this module. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A CARBURETOR.

On the designated tractor:

Clean the carburetor.

Adjust the carburetor float.

Install a carburetor repair kit.

DO NOT WRITE ON THIS PAGE

LAP TM 23

Student _____

Date _____

SERVICING A CARBURETOR

Instructor's Final Checklist

Check the student's performance in the following elements of servicing a carburetor.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. When cleaning the carburetor, the student:				
a. turned off the fuel	[ ]	[ ]	[ ]	[ ]
b. removed the carburetor	[ ]	[ ]	[ ]	[ ]
c. removed the top of the carburetor	[ ]	[ ]	[ ]	[ ]
d. cleaned all the dirt from:	[ ]	[ ]	[ ]	[ ]
1. carburetor top	[ ]	[ ]	[ ]	[ ]
2. float	[ ]	[ ]	[ ]	[ ]
3. needle valve and seat	[ ]	[ ]	[ ]	[ ]
e. cleaned both halves of the carburetor body	[ ]	[ ]	[ ]	[ ]
f. reassembled the carburetor	[ ]	[ ]	[ ]	[ ]
g. installed and adjusted the carburetor	[ ]	[ ]	[ ]	[ ]
2. When adjusting the float, the student:				
a. removed and inspected the float	[ ]	[ ]	[ ]	[ ]
b. reinstalled or replaced the float	[ ]	[ ]	[ ]	[ ]
c. checked float height	[ ]	[ ]	[ ]	[ ]
d. bent the float arm as necessary to obtain the correct float height	[ ]	[ ]	[ ]	[ ]

DO NOT WRITE ON THIS PAGE

LAP TM 23

Student _____

Date _____

SERVICING A CARBURETOR
(Continued)
Instructor's Final Checklist

Check the student's performance in the following elements of servicing a carburetor.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

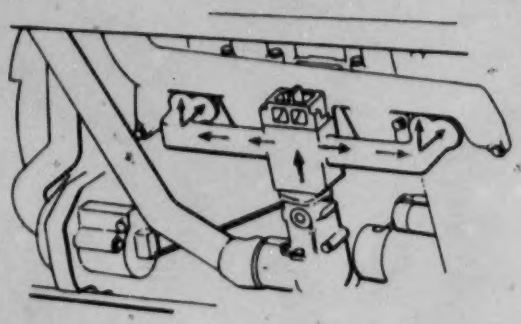
Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
3.	When installing a carburetor kit, the student:				
a.	turned off the fuel	[ ]	[ ]	[ ]	[ ]
b.	removed the carburetor	[ ]	[ ]	[ ]	[ ]
c.	separated the top and bottom of the carburetor	[ ]	[ ]	[ ]	[ ]
d.	removed the float, needle, seat, and gasket	[ ]	[ ]	[ ]	[ ]
e.	placed both halves of the carburetor body in cleaning solution for an adequate amount of time	[ ]	[ ]	[ ]	[ ]
f.	washed cleaning solution from the carburetor with very hot water	[ ]	[ ]	[ ]	[ ]
g.	blew all areas of the carburetor clean and dry with compressed air	[ ]	[ ]	[ ]	[ ]
h.	installed all new parts from kit	[ ]	[ ]	[ ]	[ ]
i.	checked and adjusted float height	[ ]	[ ]	[ ]	[ ]
j.	assembled the carburetor	[ ]	[ ]	[ ]	[ ]
k.	installed the carburetor on the engine	[ ]	[ ]	[ ]	[ ]
l.	made idle adjustments with the engine at operating temperature	[ ]	[ ]	[ ]	[ ]
m.	made load mixture adjustment with a dynamometer	[ ]	[ ]	[ ]	[ ]
n.	completed instation in less than 1 1/2 hours	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 24

Objective 125

Servicing the Intake Manifold



Courtesy of the John Deere and Company

Tractor Mechanics

INTRODUCTION

The intake manifold carries the fuel-air mixture from the carburetor to the engine. In order to do this job effectively, the intake manifold must be free of obstructions and free of leaks. In this learning activity package you will learn how to clean an intake manifold, check it for leaks, and reinstall it.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using the designated tractor, the manufacturer's service manual, and a mechanic's tool set, service the intake manifold. The manifold will be clean, correctly installed, and torqued.

LEARNING ACTIVITIES

1 READ *Fundamentals of Machine Operation: Preventive Maintenance* (Deere & Company), pp. 16, 26.

(or) _____

2 READ INSTRUCTIONS, SERVICING THE INTAKE MANIFOLD.

(or) _____

3 CHECK YOUR KNOWLEDGE of servicing the intake manifold by taking the Student Self-Check, SERVICING THE MANIFOLD.

(or) _____

4 CHECK the torque specifications for the manifold and carburetor in the manufacturer's service manual.

(or) _____

5 PRACTICE servicing the intake manifold on a lab engine.

6 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 4.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Straightedge

MATERIALS AND SUPPLIES NEEDED

1. Penetrating Oil
2. New Gasket For Manifold and Carburetor

SAFETY

No Special Precaution Necessary

INSTRUCTIONS

SERVICING THE INTAKE MANIFOLD

In servicing the intake manifold the following procedure should be used:

1. Turn off fuel.
2. Remove carburetor.
3. Remove intake manifold. The first step in this process is removal of the exhaust manifold. Use penetrating oil on nuts.
4. Clean all old gasket material from mating surfaces on manifold and engine.
5. Clean manifold inside and out. Check for warpage with straightedge and feeler gauge.
6. Determine torque specifications from manual.
7. Reinstall manifold with new gaskets; tighten to specified torque.
8. Reinstall carburetor with new gasket.
9. Turn on fuel and check for fuel leaks.

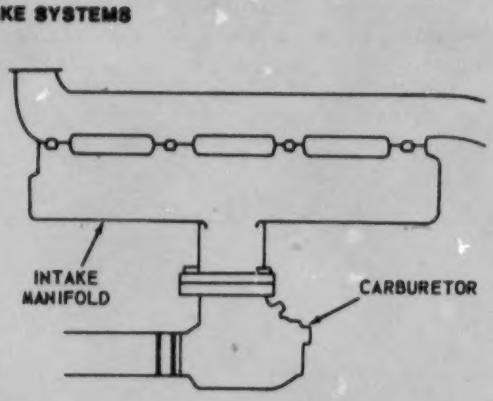


Figure 1. Typical Intake Manifold

Courtesy of John Deere and Company

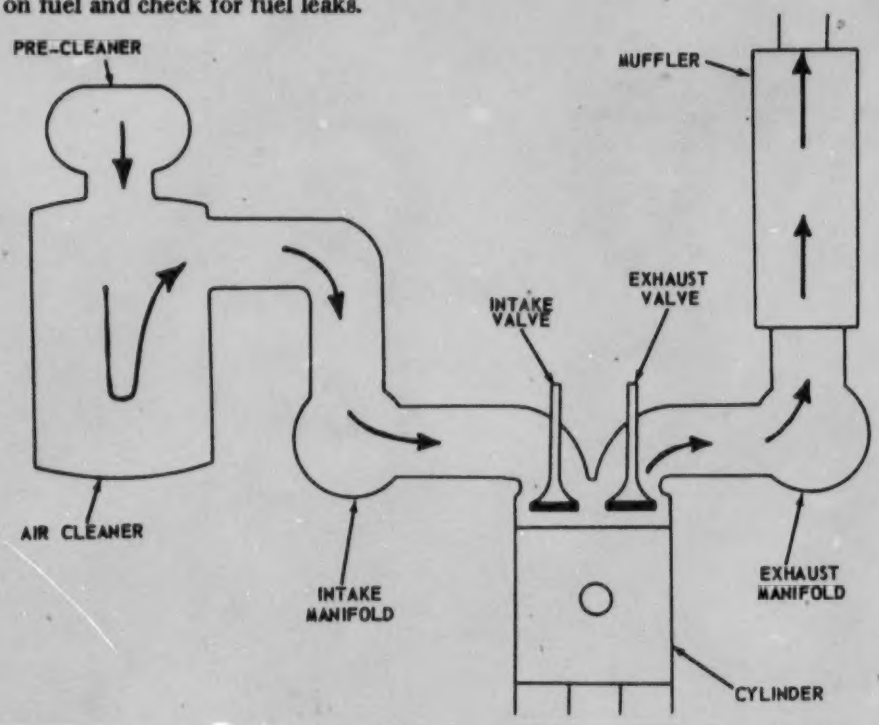


Figure 2. Intake and Exhaust Systems

Courtesy of John Deere and Company

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
SERVICING THE INTAKE MANIFOLD

1. What is the purpose of the intake manifold?

Compare your answers with the correct responses on this page. Review any incorrect answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE INTAKE MANIFOLD.

Service the intake manifold on the designated tractor.

CORRECT RESPONSE

1. The intake manifold carries the fuel-air mixture from the carburetor to the engine.

LAP TM–24

Student _____

Date _____

SERVICING THE INTAKE MANIFOLD

Instructor's Final Checklist

Check the student's performance in the following elements of servicing the intake manifold.

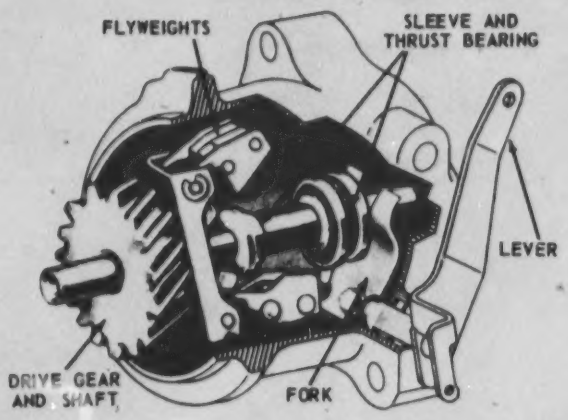
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In servicing the intake manifold, the student:				
1. Turned the fuel off first	[ ]	[ ]	[ ]	[ ]
2. Removed carburetor	[ ]	[ ]	[ ]	[ ]
3. Removed exhaust and intake manifolds	[ ]	[ ]	[ ]	[ ]
4. Cleaned all old gasket material from mating surfaces without scratching the surfaces	[ ]	[ ]	[ ]	[ ]
5. Cleaned manifold	[ ]	[ ]	[ ]	[ ]
6. Checked for warpage	[ ]	[ ]	[ ]	[ ]
7. Reinstalled manifolds with new gaskets	[ ]	[ ]	[ ]	[ ]
8. Reinstalled carburetor with new gasket	[ ]	[ ]	[ ]	[ ]
9. Torqued all nuts to specifications	[ ]	[ ]	[ ]	[ ]
10. There were no fuel leaks, and the engine started.	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 25

Objectives 14-15



Courtesy of the John Deere and Company

Servicing the Governor

Tractor Mechanics

INTRODUCTION

On tractors, the lever or pedal usually thought of as a *gas feed* or *fuel control* is actually a *governor control.* The operator sets the governor control; then the governor detects changing speed and load conditions and adjusts the throttle to maintain a steady engine speed. In this learning activity package you will learn how to repair the variable-speed governor on a gasoline tractor.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 5 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given a mechanic's tool set, shop manuals, replacement parts, and gasket compound, service an engine governor. All worn parts will be replaced and the governor will function properly.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), pp. 9-1 through 9-9.

(or) _____

2 CHECK YOUR KNOWLEDGE of governors by taking Student Self-Check, SERVICING THE GOVERNOR.

3 READ INSTRUCTIONS, SERVICING A CENTRIFUGAL GOVERNOR.

(or) _____

4 READ the section on the governor in the manufacturer's service manual for the designated tractor.

(or) _____

5 PRACTICE servicing the governor, following the procedure outlined in Instruction Sheet and the manufacturer's service manual.

6 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 5.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set

MATERIALS AND SUPPLIES NEEDED

1. Gasket Compound
2. Replacement Parts

SAFETY

No Special Precautions

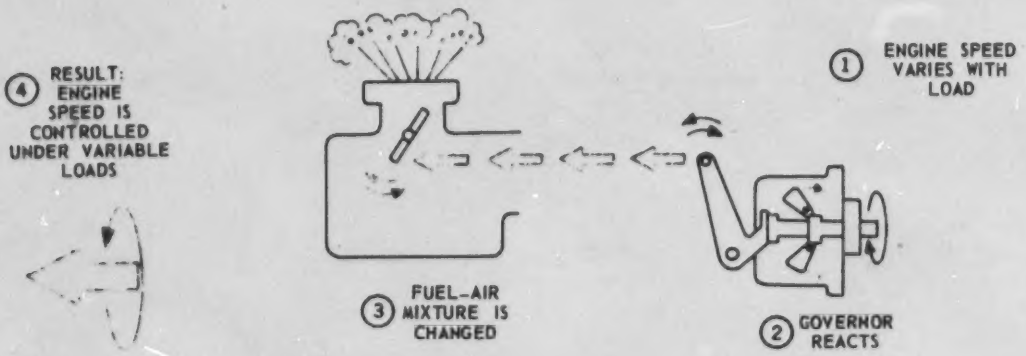

④ RESULT: ENGINE SPEED IS CONTROLLED UNDER VARIABLE LOADS
① ENGINE SPEED VARIES WITH LOAD
③ FUEL-AIR MIXTURE IS CHANGED
② GOVERNOR REACTS

Figure 1. Governing System (Gasoline Engine With Centrifugal Governor Shown)

INSTRUCTIONS

SERVICING A CENTRIFUGAL GOVERNOR

In servicing a centrifugal governor, the following procedure should be used:

1. Test engine governor for functioning.
   a. With carburetor adjusted and ignition set correctly, the engine should idle smoothly. If it does not, it probably means the governor is faulty.
   b. Engine should operate smoothly under load. If engine surges, a faulty governor is indicated.
2. Remove governor, if faulty, and disassemble.
3. Replace all worn parts and install new gaskets.
4. Reassemble and install governor.
5. Make necessary adjustments.
6. Test for proper functioning.

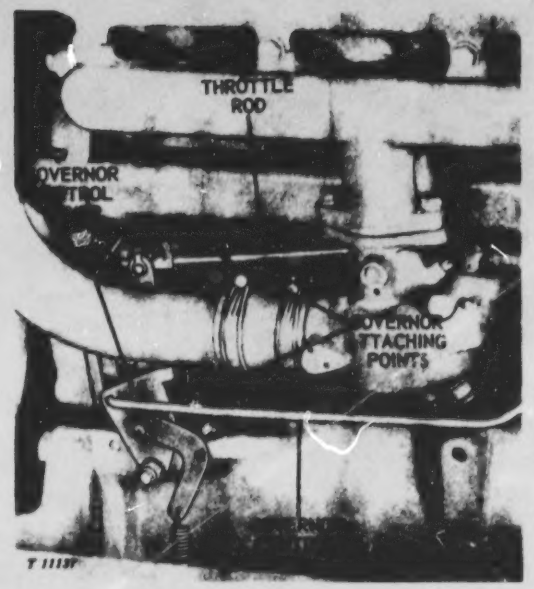


Figure 2. Governor and Linkage (Centrifugal Type Shown)

Courtesy of John Deere and Company

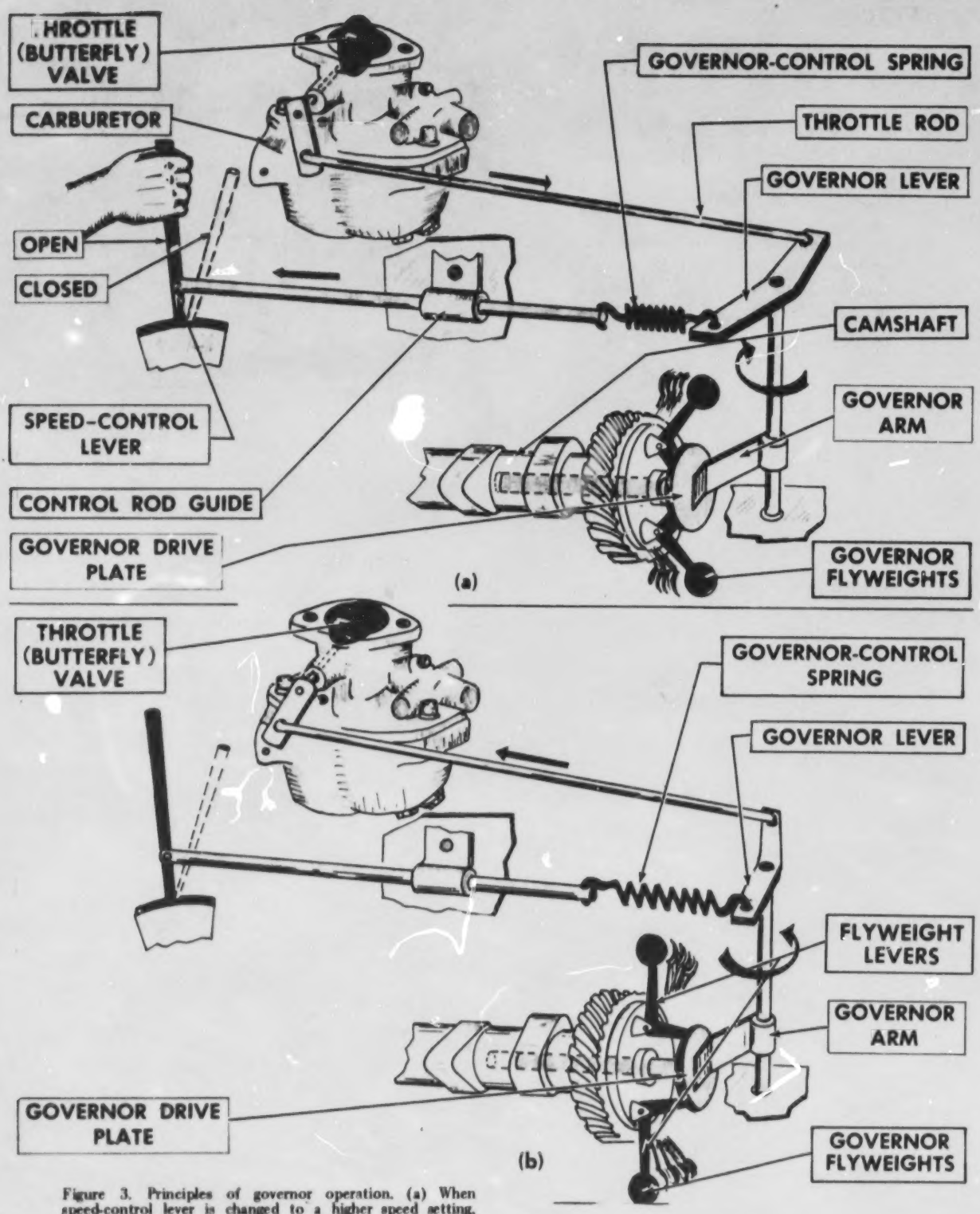


Figure 3. Principles of governor operation. (a) When speed-control lever is changed to a higher speed setting, tension increases on governor-control spring, causing the governor lever to open the throttle valve in the carburetor. Engine speed increases. (b) Increased engine speed increases centrifugal force on the governor flyweight, causing them to move outward. Flyweight levers increase pressure against the drive plate causing it to turn the governor lever in a counterclockwise direction and partly close the throttle valve. Engine speed stablizes when the centrifugal force of the flyweights is equal to the tension on the governor spring.

Courtesy of the American Association for Vocational Instructional Materials

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
SERVICING THE GOVERNOR

Answer the following:

1. What are two purposes of the governor on a tractor?
   a.
   b.

2. What is a common cause of governor "hunting"?

3. What type of governor is generally used on farm tractors?

Compare your answers with correct responses in answer box. Review any incorrect answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this module. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE GOVERNOR.

Service the engine governor on the designated tractor.

CORRECT RESPONSES

1. a. Maintain a selected speed.
   b. Limit the slow and fast speeds.
2. Incorrect carburetor adjustment
3. Centrifugal

DO NOT WRITE ON THIS PAGE

LAP TM–25

Student _____

Date _____

SERVICING THE GOVERNOR

Instructor's Final Checklist

Check the student's performance in the following elements of servicing the governor.

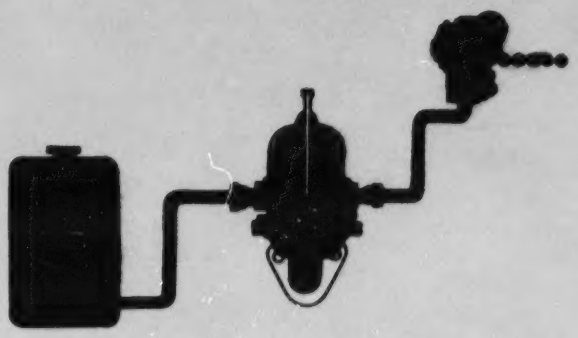
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In servicing the centrifugal governor, the student:				
1. tested the governor function at idle and under load	[ ]	[ ]	[ ]	[ ]
2. removed and disassembled the governor	[ ]	[ ]	[ ]	[ ]
3. replaced all worn parts and installed new gaskets	[ ]	[ ]	[ ]	[ ]
4. reassembled and installed governor	[ ]	[ ]	[ ]	[ ]
5. made necessary adjustments	[ ]	[ ]	[ ]	[ ]
6. tested for proper function	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 26

Objectives 82-83



The Fuel Pump Draws Fuel From The Tank To The Carburetor

Courtesy of the John Deere and Company

Servicing the Fuel Pump

Tractor Mechanics

INTRODUCTION

Not every tractor has a fuel pump. On tractors with the fuel tank higher than the carburetor, the force of gravity will transfer the fuel. But with today's new tractor designs, it is more convenient to put the tank in a position where a gravity flow system would not work. These tractors need a *fuel transfer pump*, commonly called a fuel pump. Most fuel pumps are fairly trouble-free, but any defect in the fuel pump will interfere with the fuel supply to the engine. In this learning activity package you will learn how to correct fuel pump trouble.

DIRECTIONS

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 8 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVES

1. Given assorted wrenches and screwdrivers, needle-nose pliers, and replacement parts if needed, service a fuel pump. Upon inspection there will be no leaks nor fuel dilution, and the task will be performed within five minutes of the time stated by the instructor.

2. Given a new fuel pump, a set of flare-nut wrenches, a small socket set, an open-end wrench set, sealing compound and a putty knife or scraper, replace the fuel pump on the designated tractor. When completed, the pump will show no visible signs of leaks. During the replacement process all steps on the instructor checklist will be completed.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), pp. 3-5 through 3-7.

(or) _____

2 STUDY INSTRUCTIONS A, IDENTIFYING THE PARTS OF A FUEL PUMP.

3 CHECK YOUR KNOWLEDGE of the parts of a fuel pump by completing Student Self-Check, IDENTIFYING THE PARTS OF A FUEL PUMP.

4 STUDY the section on fuel pumps in the manufacturer's service manual. READ I & T Shop Manual for Tractor Being Serviced.

5 READ INSTRUCTIONS B, SERVICING THE FUEL PUMP.

6 PRACTICE rebuilding a sample fuel pump.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 8.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set with Torque Wrench
2. Flare-Nut Wrench Set
3. Air Hose
4. Carbon Scraper or Putty Knife

MATERIALS AND SUPPLIES NEEDED

1. New Fuel Pump with Gasket
2. Gasket Cement or Compound
3. Clean Rags & Brush
4. Solvent for Cleaning

SAFETY

No Special Precautions

INSTRUCTIONS

A IDENTIFYING THE PARTS OF A FUEL PUMP

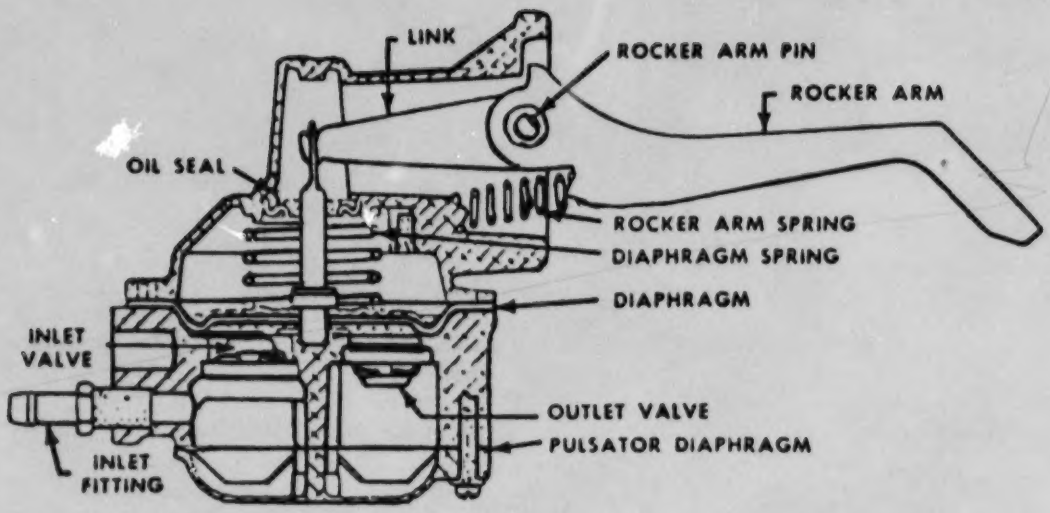


Figure 1. Fuel Pump

Courtesy of John Deere and Company

INSTRUCTIONS

B. SERVICING THE FUEL PUMP

In servicing a fuel pump, the following procedure should be used:

1. Pull engine oil dipstick and smell oil for gasoline or diesel fuel. If oil is thin or diluted and/or dipstick indicates that the engine oil level is overfull, this may indicate a hole in the pump diaphragm.
2. Check pump for correct pumping action.
3. Turn fuel supply off. Remove fuel lines to pump, and remove pump from engine.
4. Remove screws from top of fuel pump; lift top half of fuel pump off, being careful not to damage the diaphragm.

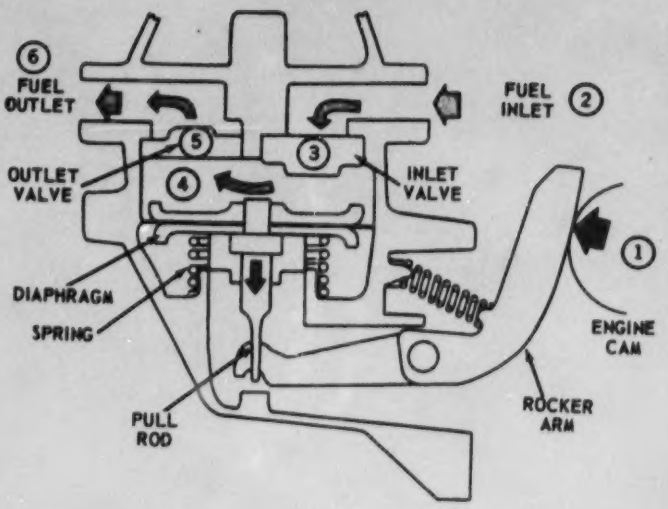


Figure 3. Operation of a Fuel Pump

Courtesy of John Deere and Company

5. Inspect the diaphragm on the remaining half of the pump. Replace diaphragm, if needed, and align with holes in pump body.
6. Reinstall top of fuel pump and tighten screws.
7. Reinstall fuel pump on engine, connect lines and turn on fuel valve.
8. Change diluted oil.
9. Start engine and let run for several minutes. Check for fuel and oil leaks. (Note: In the event the fuel pump is a sealed type, replace with new pump.)

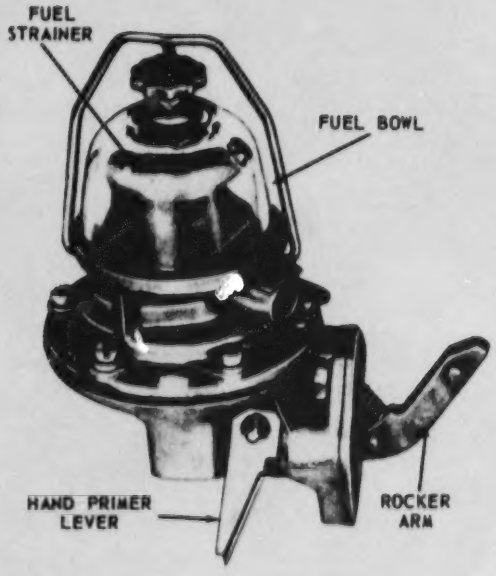


Figure 2. Typical Fuel Pump.

Courtesy of John Deere and Company.

C. In replacing a fuel pump the following procedure should be used:

1. Turn off fuel.
2. Remove fuel lines from pump.
3. Unbolt pump from engine.
4. Clean area where gasket fits to engine.
5. Compare new pump to old one to insure a correct match.
6. Coat the gasket with appropriate sealing compound.
7. Install gasket and pump being certain that actuating arm bears correctly against cam or push rod. (May need to turn engine over to reduce cam pressure on actuating arm.)
8. Torque attachment bolts (if torque specs are available).
9. Reconnect fuel lines.
10. Turn on fuel and check for leaks.
11. Start engine and check for leaks.

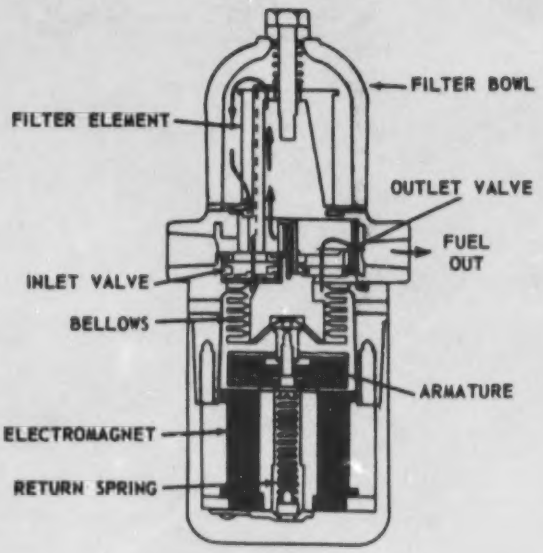
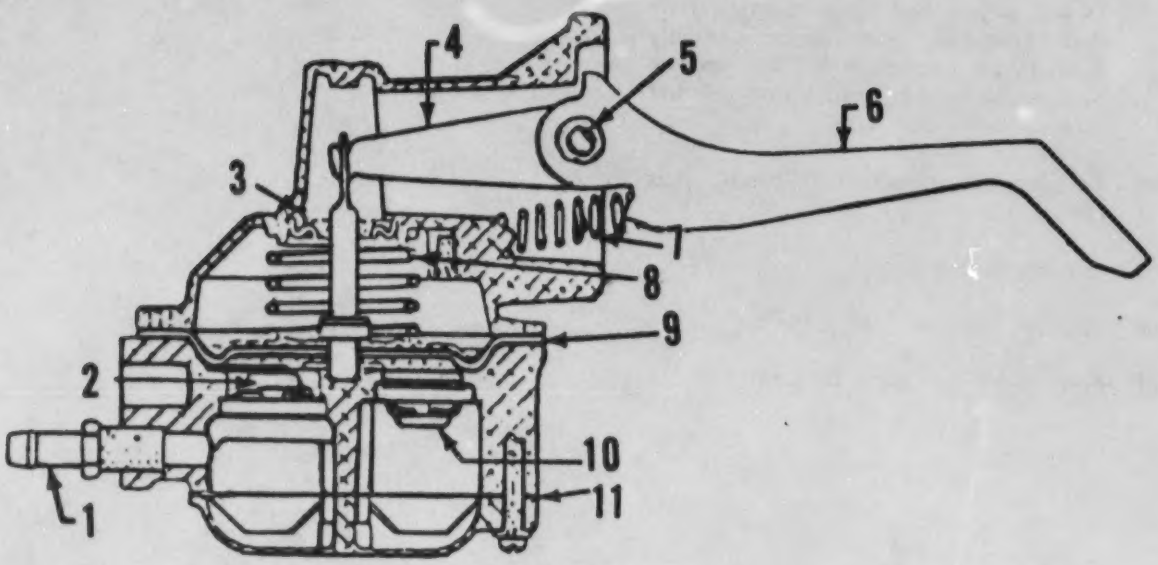


Figure 4. Cutaway View of Electric Fuel Pump

Courtesy of John Deere and Company

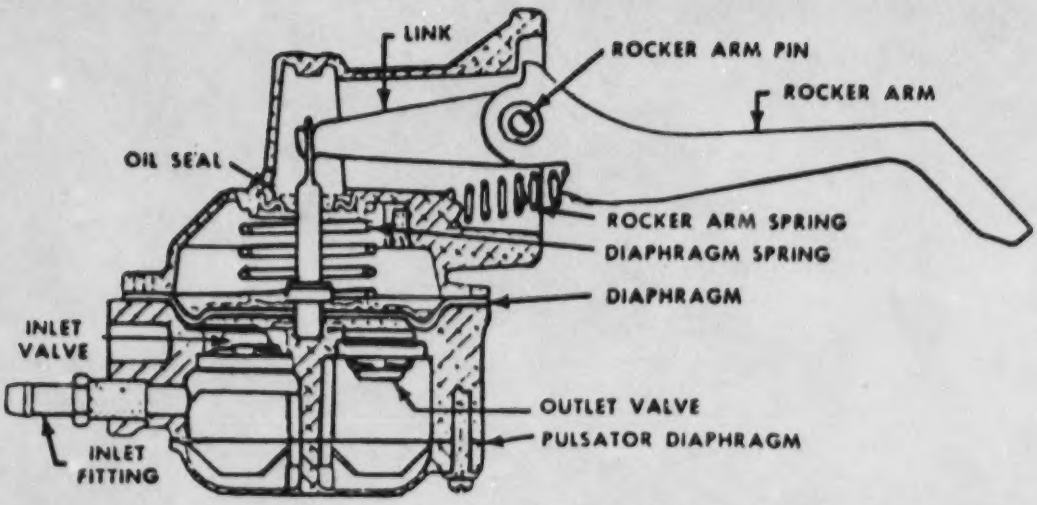
STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
IDENTIFYING THE PARTS OF A FUEL PUMP

Label the parts of a fuel pump on the following diagram:



CORRECT RESPONSES

IDENTIFYING THE PARTS OF A FUEL PUMP



CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE FUEL PUMP.

Service the fuel pump on the designated tractor.

Replace the fuel pump on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP TM–26

Student _____

Date _____

SERVICING THE FUEL PUMP

Instructor's Final Checklist

Check the student's performance in the following elements of servicing the fuel pump.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	In servicing the fuel pump, the student:				
	a. checked the pump for defects	[ ]	[ ]	[ ]	[ ]
	b. turned off the fuel	[ ]	[ ]	[ ]	[ ]
	c. removed the pump from the engine	[ ]	[ ]	[ ]	[ ]
	d. dismantled the pump	[ ]	[ ]	[ ]	[ ]
	e. replaced the needed parts	[ ]	[ ]	[ ]	[ ]
	f. reassembled the pump	[ ]	[ ]	[ ]	[ ]
	g. reinstalled the pump	[ ]	[ ]	[ ]	[ ]
	h. changed the oil (if necessary)	[ ]	[ ]	[ ]	[ ]
	i. started the engine and checked for leaks	[ ]	[ ]	[ ]	[ ]
	j. completed the task within five minutes of the time set by the instructor	[ ]	[ ]	[ ]	[ ]
2.	In replacing the fuel pump, the student:				
	a. turned off the fuel	[ ]	[ ]	[ ]	[ ]
	b. removed the pump	[ ]	[ ]	[ ]	[ ]
	c. cleaned the area	[ ]	[ ]	[ ]	[ ]

DO NOT WRITE ON THIS PAGE

LAP TM–26

Student _____

Date _____

SERVICING THE FUEL PUMP

Instructor's Final Checklist (Cont'd)

Check the student's performance in the following elements of servicing the fuel pump.

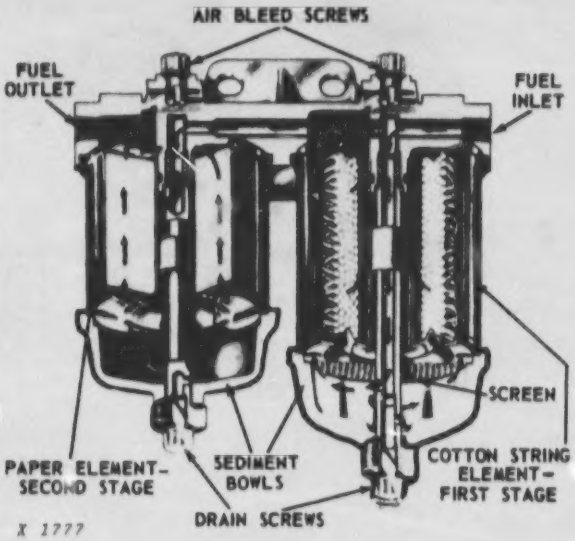
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
d.	installed gaskets and pump	[ ]	[ ]	[ ]	[ ]
e.	torqued bolts to specifications	[ ]	[ ]	[ ]	[ ]
f.	reconnected fuel lines	[ ]	[ ]	[ ]	[ ]
g.	checked for leaks	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 27

Objective 86



Fuel Filters (Dual Series-Type Shown)

Courtesy of the John Deere and Company

Servicing the Diesel Fuel Filters

Tractor Mechanics

INTRODUCTION

Since many of the tractors brought into the shop have diesel engines, the mechanic must be able to service diesel fuel filters. Clean fuel is vital in the diesel engine because the injection parts are precision made. The diesel engine is rugged and will last many years if the filter system is maintained. But the service life of the injection pump and injector nozzles may be only a few hours if dirt particles and water are allowed to reach them. In this learning activity you will learn how to properly service the diesel fuel filters.

DIRECTIONS

Before you start work on this learning activity package, be sure you have completed Learning Activity Package, BLEEDING THE DIESEL FUEL SYSTEM.

If you have completed this Learning Activity Package, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 5 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using the designated tractor, the manufacturer's service manual, replacement filters and gaskets, clean rags, and suitable wrenches, service the diesel fuel filters. The fuel system should be clean and free of leaks. It should also be bled properly, and the engine should start.

LEARNING ACTIVITIES

1 READ *Tractor Maintenance: Principles and Procedures* (AAVIM) pp. 108-112.

(or) _____

2 READ *Fundamentals of Machine Operation: Preventive Maintenance*, p.50.

(or) _____

3 CHECK YOUR KNOWLEDGE of the diesel fuel filter system by taking Student Self-Check, UNDERSTANDING DIESEL FUEL FILTERS.

4 READ INSTRUCTIONS, SERVICING THE DIESEL FUEL FILTERS.

(or) _____

5 STUDY the section on servicing the diesel fuel filters in the manufacturer's service manual for the designated tractor or I & T Shop Manual For the Tractor Being Serviced.

(or) _____

6 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

7 PRACTICE servicing the fuel filters on the designated tractor. Follow the procedure outlined in the manufacturer's service manual and Learning Activity 4.

8 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 5.

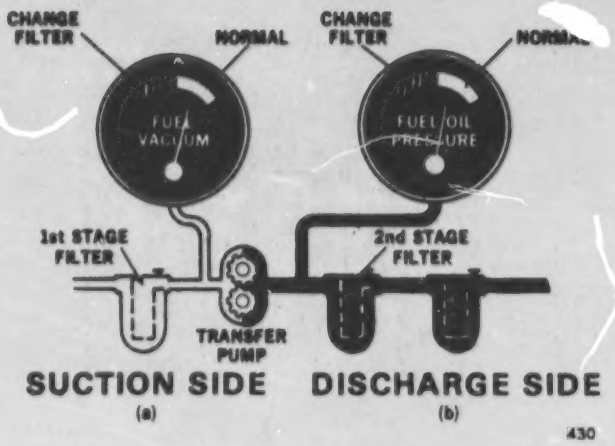


Figure 1. Gages used to indicate when fuel filters need changing. (a) Vacuum gage is used to determine condition of filter on suction side of transfer pump. As the first-stage filter clogs, pump suction will increase, causing pointer to move to red area on vacuum gage. (b) Pressure gage used on discharge side of pump. As second-stage filter clogs, increased pressure is required to force fuel through it, causing pressure-gage pointer to move to red or "change" area.

Courtesy of the American Association for Vocational Instructional Materials

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Manufacturer's Operator's Manual
3. I & T Shop Manual For Designated Tractor
4. Air Hose

MATERIALS AND SUPPLIES NEEDED

1. Replacement Filters
2. Filter Gaskets
3. Parts Washing Brush & Solvent
4. Clean Rags

SAFETY

Be sure to catch fuel that is wasted from the fuel line in some kind of container to prevent fire hazard.

INSTRUCTIONS

SERVICING THE DIESEL FUEL FILTERS

In servicing the diesel fuel filters, the procedure in the manufacturer's service manual should be followed if it differs from the instructions below.

1. Check the manufacturer's service manual for correct order and procedure.
2. Obtain correct filter elements for make and model of machine.
3. Shut off fuel. (CAUTION: Keep tools and parts clean of foreign materials.)
4. Remove primary filter, clean the container, and install new filter.
5. Remove old gasket and install new gasket (included in new element kit).
6. Reinstall filter element and container on engine.
7. Tighten bolt to compress gasket (do not over tighten; distortion of the container could result).
8. Repeat procedures 4-7 with secondary filter.
9. Turn on fuel.
10. Bleed system and start engine.
11. Check filter for leaks and wipe off excess fuel to prevent dust accumulation.

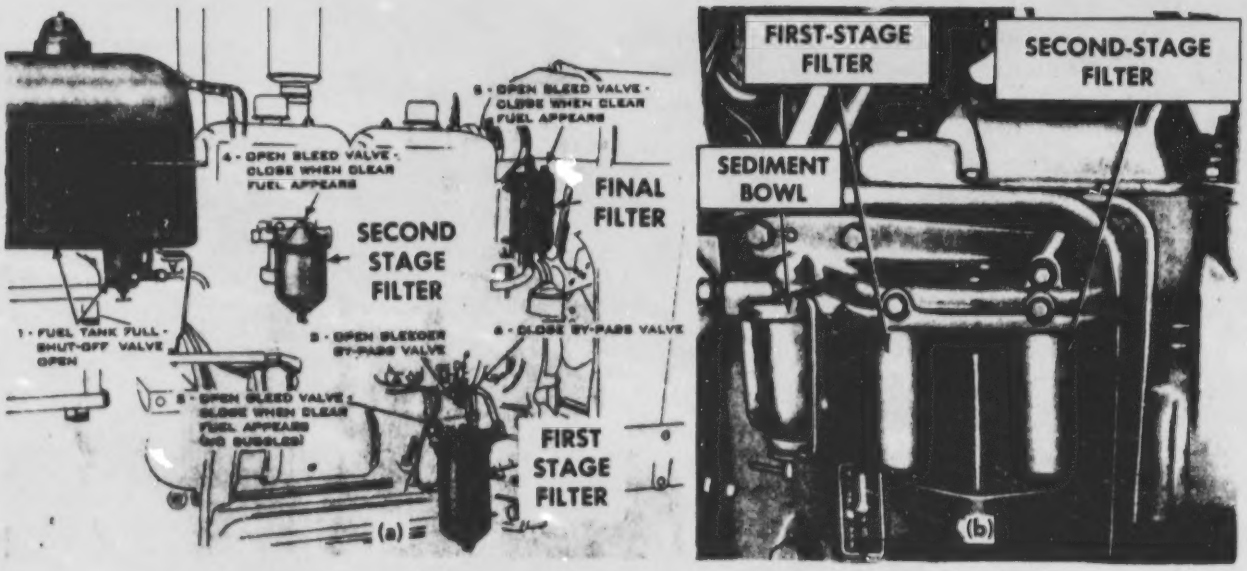

4 - OPEN BLEED VALVE - CLOSE WHEN CLEAR FUEL APPEARS
SECOND STAGE FILTER
5 - OPEN BLEED VALVE - CLOSE WHEN CLEAR FUEL APPEARS
FINAL FILTER
1 - FUEL TANK FULL - SHUT-OFF VALVE OPEN
3 - OPEN BLEEDER BY-PASS VALVE
6 - CLOSE BY-PASS VALVE
2 - OPEN BLEED VALVE - CLOSE WHEN CLEAR FUEL APPEARS (NO BUBBLES)
FIRST STAGE FILTER
(a)
FIRST-STAGE FILTER
SECOND-STAGE FILTER
SEDIMENT BOWL
(b)

Figure 2. Types of fuel filter arrangements on farm tractors. (a) Distributed arrangement with filters at different locations on side of tractor. (b) Cluster arrangement of sediment bowl and filters.

Courtesy of the American Association for Vocational Instructional Materials

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!

UNDERSTANDING DIESEL FUEL FILTERS

Write a short answer for the following:

1. Why is it more important to keep a diesel engine fuel system clean than to keep a gasoline engine fuel system clean?

2. Two contaminants which are especially harmful in a diesel fuel injector are _____ and _____.

3. How does the operator know when to service a diesel fuel system?

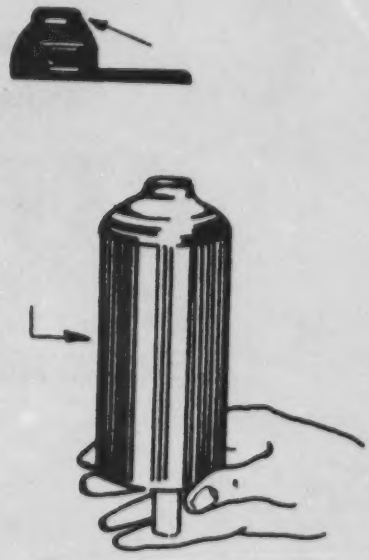
4. Which stage filter must be changed most frequently?

5. According to the John Deere publication *Fundamentals of Machine Operation: Preventive Maintenance*, filters should normally be changed every ____hours. The second stage filter should be changed every____ hours.

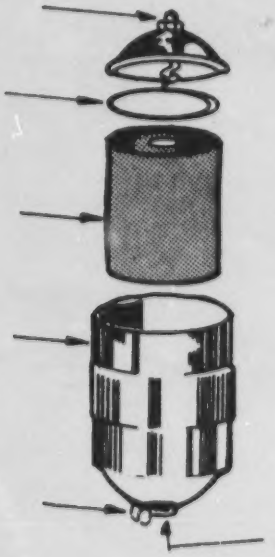
6. Identify each of the following types of filters.

Compare your answers with the correct responses on the following page. Review any incorrect answers before going on to the next Learning Activity.

B. _____



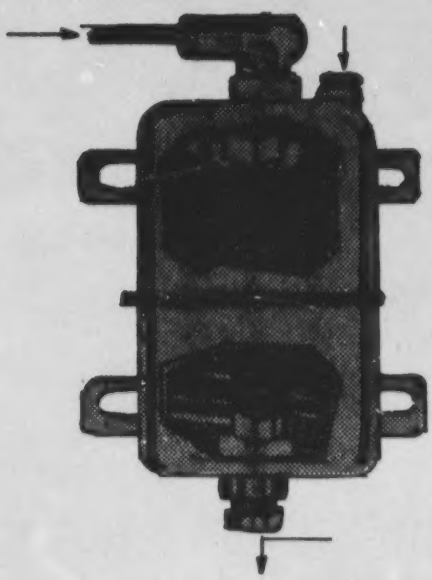
A. _____



C. 58 _____

CORRECT RESPONSES

1. Because the very small openings in the injector nozzles are easily stopped up.
2. Water, dirt
3. By checking the manufacturer's service manual
4. First stage
5. 500, 1000
6. a) edge-type
   b) yarn-type
   c) paper element in a perforated can
   d) paper filter in its own casing
   e) sealed paper filter



E. _____

D. _____

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE DIESEL FUEL FILTERS.

Service the diesel fuel filters on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP TM–27

Student _____

Date _____

SERVICING THE DIESEL FUEL FILTERS

Instructor's Final Checklist

Check the student's performance in the following elements of servicing the diesel fuel filters.

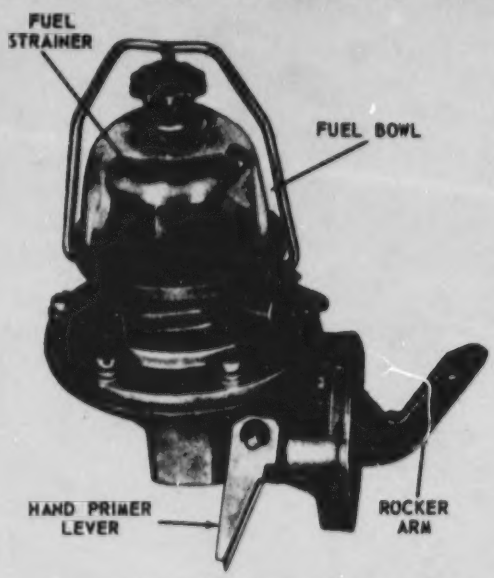
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In servicing the diesel fuel filter system, the student:				
a. checked the manufacturer's service manual for the correct procedure	[ ]	[ ]	[ ]	[ ]
b. shut off the fuel	[ ]	[ ]	[ ]	[ ]
c. removed the primary filters	[ ]	[ ]	[ ]	[ ]
d. cleaned the container	[ ]	[ ]	[ ]	[ ]
e. installed a new gasket	[ ]	[ ]	[ ]	[ ]
f. installed a new filter	[ ]	[ ]	[ ]	[ ]
g. tightened the bolt to the filter	[ ]	[ ]	[ ]	[ ]
h. serviced the secondary filter	[ ]	[ ]	[ ]	[ ]
i. bled the system	[ ]	[ ]	[ ]	[ ]
2. After servicing the fuel filter system, the student:				
a. started the engine	[ ]	[ ]	[ ]	[ ]
b. checked the filter for leaks	[ ]	[ ]	[ ]	[ ]
c. wiped off the excess fuel to prevent dust accumulation	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 28

Objective 89



— Fuel Transfer Pump (Diaphragm Type)

Courtesy of the John Deere and Company

Servicing a Diesel Transfer Pump

Tractor Mechanics

INTRODUCTION

While the diesel is in the shop for servicing the fuel filter, the mechanic should also service the transfer pump. The transfer pump is driven by the engine and supplies fuel to the injection pump. If the transfer pump is not properly serviced and maintained, it may fail, resulting in "down time" during the busy season. In this learning activity package you will learn how to properly service the transfer pump.

DIRECTIONS

Before you begin this learning activity package, be sure you have completed Learning Activity Package 31, BLEEDING THE DIESEL FUEL SYSTEM.

If you have completed this Learning Activity Package, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 5 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using the designated tractor, a Roosa-Master service manual, screwdrivers, a micrometer, and a torque wrench, service a diesel transfer pump. The removal and reinstallation should meet Roosa-Master specifications for its fuel transfer pump, and the job should take no more than an hour.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), pp. 3-5 to 3-7, 5-4 and 5-18.

(or) _____

2 READ INSTRUCTIONS, SERVICING A DIESEL TRANSFER PUMP.

(or) _____

3 STUDY the section on servicing a diesel transfer pump in the manufacturer's service manual for the designated tractor or I & T Shop Manual on tractor being serviced.

(or) _____

4 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

5 PRACTICE cleaning and servicing the diesel transfer pump on the designated tractor. Follow the procedure outlined in the tractor manufacturer's service manual, the Roosa-Master service manual, I & T Shop Manual, and/or Learning Activity 2.

6 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 5.

TOOLS AND EQUIPMENT NEEDED

1. Screwdrivers
2. Micrometer
3. Torque Wrench

MATERIALS AND SUPPLIES NEEDED

Roosa-Master Service Manual

SAFETY

No special safety precautions necessary

INSTRUCTIONS

SERVICING A DIESEL TRANSFER PUMP

In servicing a piston-type diesel transfer pump, the procedure outlined in the manufacturer's service manual should be followed if it differs from the procedure given below. (NOTE: For the procedure in servicing a diaphragm-type transfer pump, see Learning Activity Package TM-26.)

1. Clean pump and work area completely.
2. Remove hydraulic head assembly.
3. Remove end plate.
4. Remove the end-plate seal from the top of the end-plate sleeve with a dull scribe.
5. Remove the sleeve with a Roosa-Master tool No. 1704. Use a rotary motion to prevent damage of the O-Ring seal on sleeve.
6. Remove priming by-pass spring at the bottom of the sleeve bore.
7. Remove the transfer pump seal O-Ring.
8. Remove the transfer pump liner from the pump. Remove pump blades, being careful not to lose any attached springs.
9. Wash transfer pump in clean fuel oil.
10. Check pump liner and blades for scratches which could cause problems.
11. If they are in one piece, measure blades with a micrometer (minimum width is 27.76 m); if it is not correct, replace both blades.
12. Insert priming by-pass spring into end plate.

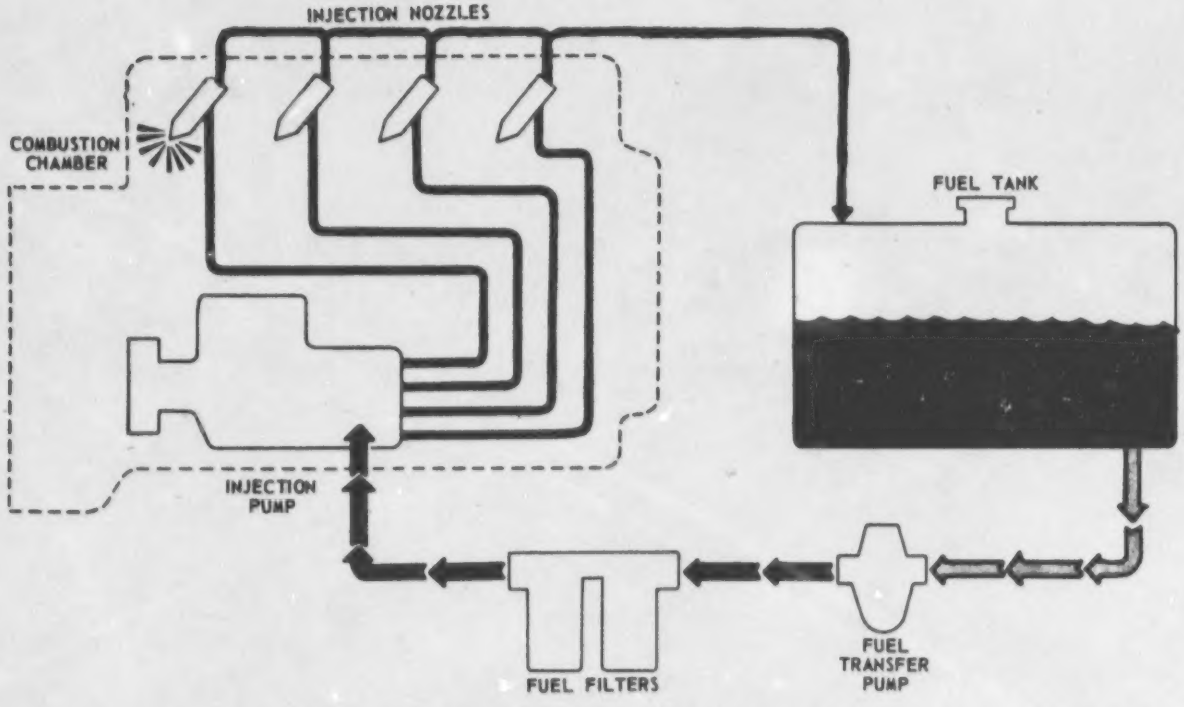


Figure 1. Diesel Fuel System (Distributor Type Shown)

Courtesy of John Deere and Company

13. Place plunger in end-plate sleeve and shake to be sure plunger is free to move in bore.

14. With twisting motion to prevent seal damage, insert sleeve into end plate with Roosa-Master tool No. 1704.

15. Assemble regulating spring in bore; install end-plate plug and tighten.

16. Wash transfer pump liner and place in position.

17. Insert blades carefully with one vertical and the other horizontal.

18. Install end-plate sealing ring.

19. Turn liner so that notched slot will align with roll pin in end-plate assembly, and install end-plate assembly.

20. Insert screws and tighten to 36-39 in. lbs.

21. Reinstall fuel lines and bleed system.

22. Check fuel pump pressure if problems exist. It should not exceed 130 lbs. (8.96 bars) and should be a minimum 18-22 psi (1.24-1.51 bars) at 225 pump rpm.

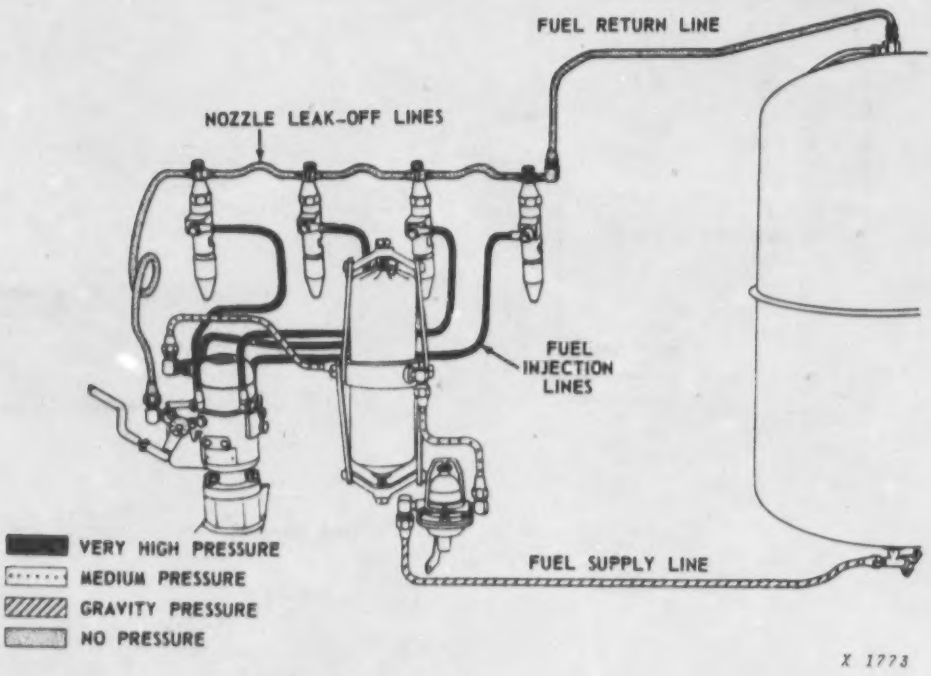


Figure 2. Fuel Lines In A Diesel Fuel System

Courtesy of John Deere and Company

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
SERVICING A DIESEL TRANSFER PUMP

1. Briefly explain the function of the diesel transfer pump.

2. List the parts of a diesel fuel transfer pump.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

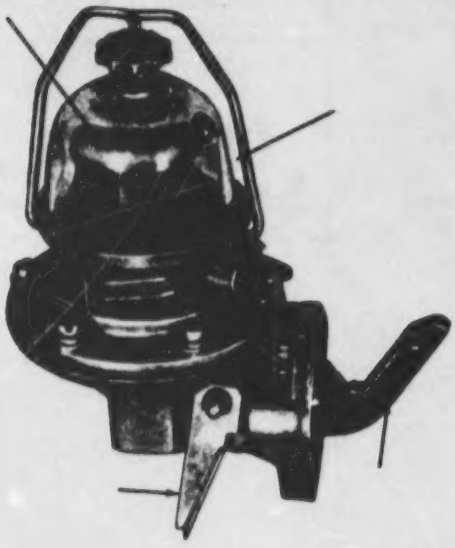


Figure 3. Fuel Transfer Pump (Diaphragm Type)

Courtesy of John Deere and Company

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A DIESEL TRANSFER PUMP.

Service the diesel transfer pump on the designated tractor.

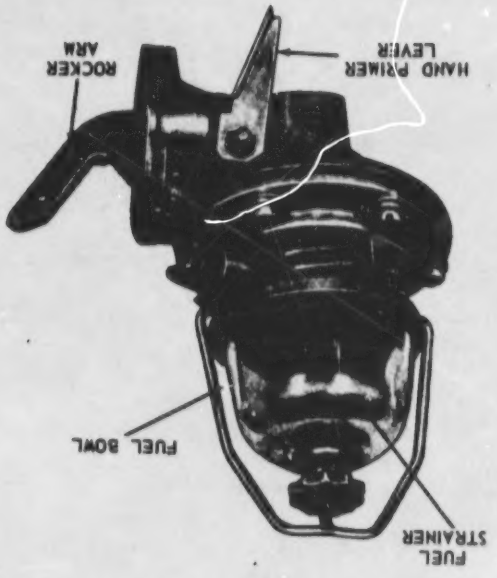


Figure 4. Fuel Transfer Pump (Diaphragm Type)

Courtesy of John Deere and Company

CORRECT RESPONSES

1. The transfer pump supplies fuel to the injection pump.

2. See Figure 4.

DO NOT WRITE ON THIS PAGE

LAP TM–28

Student _____

Date _____

SERVICING A DIESEL TRANSFER PUMP

Instructor's Final Checklist

Check the student's performance in the following elements of servicing a diesel transfer pump.

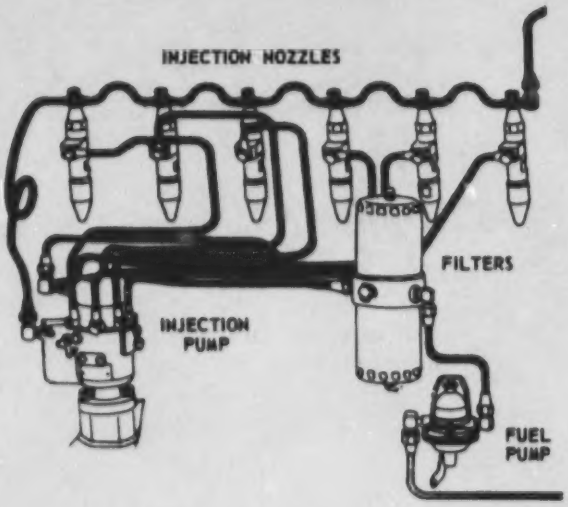
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	In servicing the diesel transfer pump, the student:				
a.	cleaned the pump and work area	[ ]	[ ]	[ ]	[ ]
b.	removed the transfer pump without damage	[ ]	[ ]	[ ]	[ ]
c.	washed the transfer pump in clean fuel oil	[ ]	[ ]	[ ]	[ ]
d.	measured and replaced defective blades	[ ]	[ ]	[ ]	[ ]
e.	reassembled the transfer pump to specifications	[ ]	[ ]	[ ]	[ ]
f.	bled the system	[ ]	[ ]	[ ]	[ ]
g.	checked the fuel pump pressure	[ ]	[ ]	[ ]	[ ]
h.	completed the job within one hour	[ ]	[ ]	[ ]	[ ]
2.	After being serviced by the student, the transfer pump:				
a.	held a pressure reading which agreed with the specifications in the manufacturer's service manual	[ ]	[ ]	[ ]	[ ]
b.	had no leaks	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 29

Objective 88



Courtesy of the John Deere and Company

Servicing a Diesel Injection Pump

Tractor Mechanics

INTRODUCTION

One of the most important parts on a diesel engine is the fuel injection pump. The job of the injection pump is to deliver the correct amount of fuel at the right time and at the correct rate of flow. By proper servicing of the injection pump, such problems as difficulty in starting, engine knock, rough idling, and loss of power can be kept at a minimum. In this learning activity package you will learn how to service the fuel injection pump.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 5 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given wrenches to fit bolts encountered, a strobe-light tachometer and other special tools to check timing for the pump, service a diesel injection pump for minor adjustments. The timing will be to manufacturer's specifications and within 5% of the manufacturer's specifications of the high and low idle, as checked by the instructor.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), Chapter 5, pp. 6-13.

(or) _____

2 VIEW slides 1-26, "Installing the Roosa-Master D-Series Pump," (Vocational Agriculture Service, University of Illinois).

(or) _____

3 CHECK YOUR KNOWLEDGE of injection pumps by taking Student Self-Check, UNDERSTANDING DIESEL INJECTION PUMPS.

4 READ INSTRUCTIONS, SERVICING A DIESEL INJECTION PUMP.

(or) _____

5 STUDY the section on servicing a diesel injection pump in the manufacturer's service manual for the designated tractor, or I & T Shop Manual.

(or) _____

6 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

7 PRACTICE servicing the diesel injection pump on the designated tractor. Follow the procedure outlined in Learning Activity 4 and the manufacturer's service manual.

8 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 5.

TOOLS AND EQUIPMENT NEEDED

1. Strobe-Light Tachometer
2. Mechanic's Tool Set

MATERIALS AND SUPPLIES NEEDED

1. Clean Rags
2. Solvent and Container
3. Brush
4. Compressed Air

SAFETY

Use extreme care when servicing fuel injection pump to guard against fire hazards.

INSTRUCTIONS

SERVICING A DIESEL INJECTION PUMP

In servicing the diesel injection pump, the following procedure should be used:

(Note: Service of the workings of a diesel injection pump requires much precise equipment and special schooling. Most dealers have this work done at special diesel shops. Below are some of the basic points that a dealer might need to do on an injection pump in his shop. CAUTION: Never attempt to increase the fuel to an engine unless the correct equipment is used to do the job to exact specifications. And never loosen a pump while the engine is turning as it could twist and cause serious damage to your hands as well as to the engine.)

1. Check the manufacturer's specifications of the engine for high idle, low idle, and basic engine timing.
2. Rotate the engine until the correct degree of timing comes up at the flywheel or front pulley.
3. Remove the plug at the pump or the plate on the pump to see if the timing marks are in line according to the manufacturer's specifications.
4. If timing marks are not in line, loosen retaining bolts and rotate the pump clockwise or counterclockwise until the marks are exactly in line. Place a transparent plastic cover plate over the timing marks on pump.
5. Retighten the pump bolts and start the engine. Be sure that the timing marks are aligned and that they advance properly.

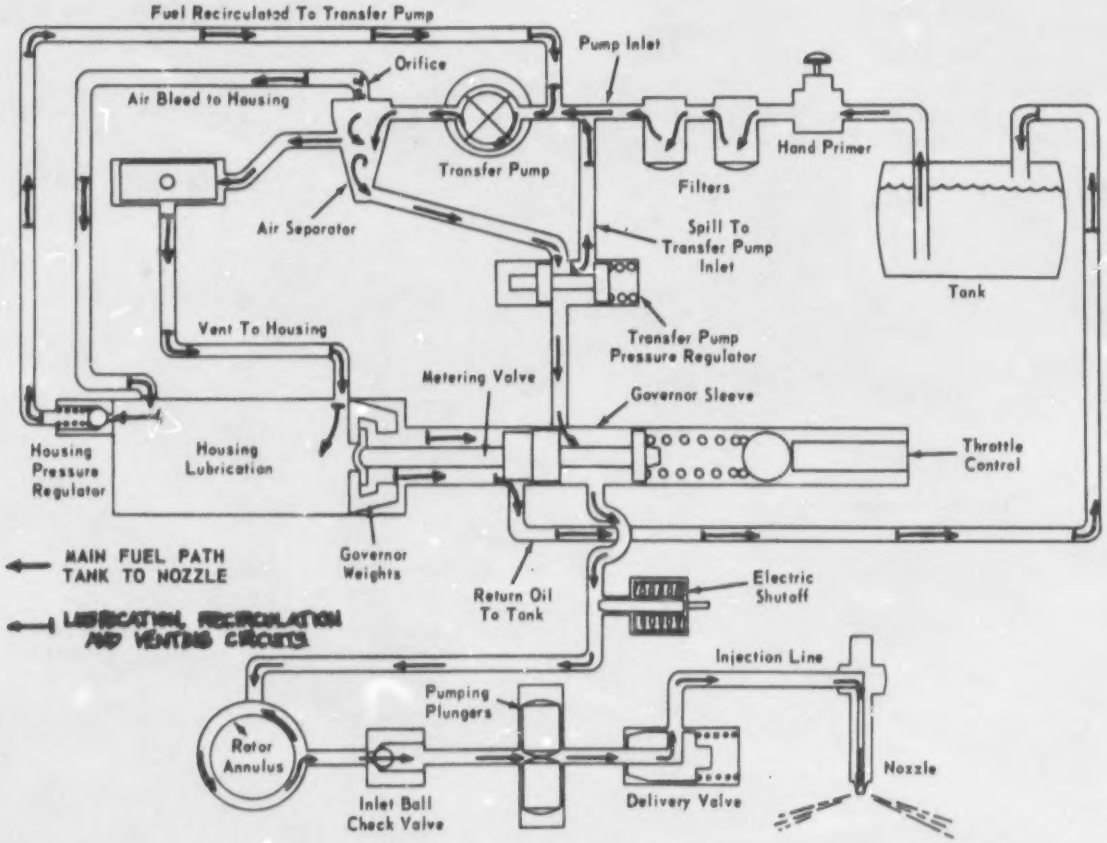


Figure 1. Fuel Flow in Distributor Injection Pump

Courtesy of John Deere and Company

6. With a strobe tachometer, take a reading of the engine RPM at low idle; compare with the specifications.

7. Rotate the low-idle stop of the governor control until the correct low idle is reached. Lock the low-idle screw down and install a sealing wire to prevent future movement.

8. Move the fuel control lever to high idle and compare the tachometer reading with the manufacturer's specifications.

9. Move the high-idle adjustment screw until the manufacturer's recommended setting is reached and lock down with jam nuts. Install a locking wire to prevent further movement.

10. Operate the engine at high idle and check for loose fittings and leaky lines.

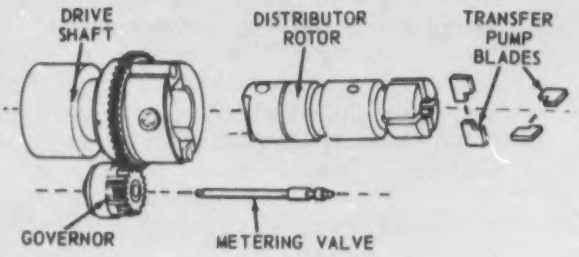
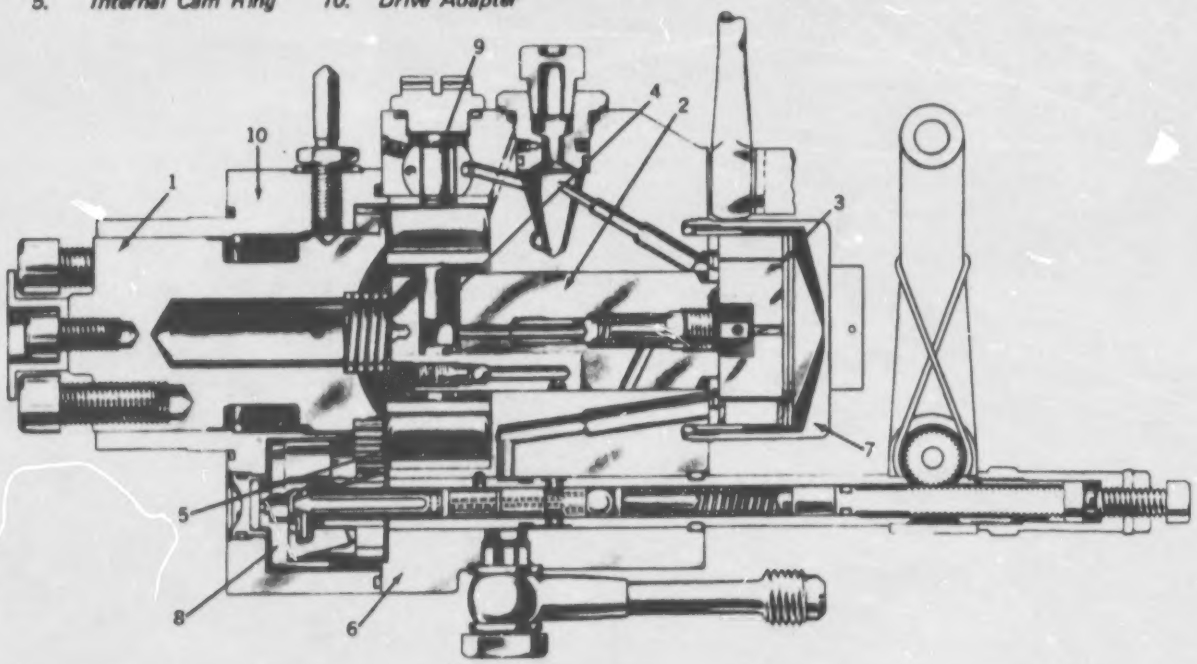


Figure 3. Main Rotating Parts Of Injection Pump

Courtesy of John Deere and Company

The main parts of the pump as shown in Fig. 2 are:

1. *Drive Shaft*
2. *Distributor Rotor*
3. *Transfer Pump*
4. *Pumping Plungers*
5. *Internal Cam Ring*
6. *Hydraulic Head*
7. *End Cap*
8. *Governor*
9. *Automatic Advance*
10. *Drive Adapter*



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Courtesy of John Deere and Company

STUDENT SELF-CHECK
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UNDERSTANDING DIESEL INJECTION PUMPS

Answer the following:

1. If the injection pump is made up of injector nozzle and pump, there is no high pressure line. (T or F)

2. What are the functions of the injector system?

3. Pressures of up to 5000 PSI (345 bars) can be reached by some fuel injection pumps. (T or F)

4. The three main types of injection systems are:

5. The four major ways of injecting fuel are:

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this module. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A DIESEL INJECTION PUMP.

Service the specified diesel injection pump for minor adjustments.

CORRECT RESPONSES

1. False

2. a) Supply the correct amount of fuel
   b) Time fuel delivery
   c) Control rate of delivery
   d) Atomize fuel
   e) Distribute fuel in combustion chamber

3. True

4. a) Common rail
   b) Accumulator
   c) Jerk pump

5. a) Individual pump and nozzle
   b) Combined pump and nozzle
   c) Pumps in common housing, nozzles for each cylinder
   d) One pump serving nozzles for several cylinders

DO NOT WRITE ON THIS PAGE

LAP TM–29

Student _____

Date _____

SERVICING A DIESEL INJECTION PUMP

Instructor's Final Checklist

Check the student's performance in the following elements of servicing a diesel injection pump.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In servicing the diesel injection pump, the student:				
a. checked the manufacturer's specifications of the engine for high idle, low idle, and basic engine timing	[ ]	[ ]	[ ]	[ ]
b. rotated the engine until the correct degree of timing came up at the flywheel	[ ]	[ ]	[ ]	[ ]
c. removed the plug at the pump or on the plate of the pump to see if the timing marks were in line	[ ]	[ ]	[ ]	[ ]
d. loosened the retaining bolts and rotated the pump clockwise or counterclockwise until the marks were exactly in line	[ ]	[ ]	[ ]	[ ]
e. retightened the bolts and started the engine	[ ]	[ ]	[ ]	[ ]
f. checked timing and advance	[ ]	[ ]	[ ]	[ ]
g. took a reading of the engine RPM at low idle and compared with the specifications	[ ]	[ ]	[ ]	[ ]
h. rotated the low-idle stop of the governor control until the correct low idle was reached	[ ]	[ ]	[ ]	[ ]
i. locked the low-idle screw down and installed a sealing wire to prevent movement	[ ]	[ ]	[ ]	[ ]
j. moved the fuel control lever to high idle and compared the tachometer reading with the manufacturer's specifications	[ ]	[ ]	[ ]	[ ]

DO NOT WRITE ON THIS PAGE

LAP TM–29

Student _____

Date _____

SERVICING A DIESEL INJECTION PUMP (Continued)

Instructor's Final Checklist

Check the student's performance in the following elements of servicing a diesel injection pump.

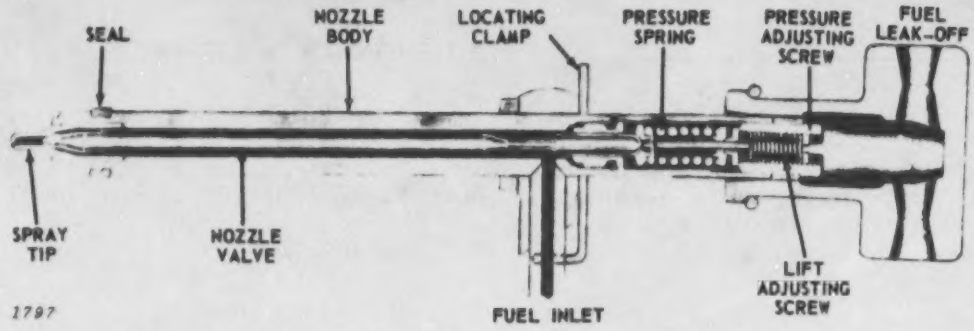
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
k.	moved the high-idle adjusting screw until the manufacturer's recommended setting was reached	[ ]	[ ]	[ ]	[ ]
l.	locked down high-idle adjusting screw with a jam nut and installed a locking wire to prevent movement	[ ]	[ ]	[ ]	[ ]
m.	operated the engine at high idle and checked for loose fittings and leaky lines	[ ]	[ ]	[ ]	[ ]
2.	After being serviced by the student, the injector pump:				
a.	supplied the correct quantity of fuel to the engine for smooth operation	[ ]	[ ]	[ ]	[ ]
b.	delivered the fuel to the engine at the correct time	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 30

Objective 87



— Typical Injection Nozzle Which Opens Inward and Operates By Pressure Differences

Servicing a Diesel Fuel Injector

Tractor Mechanics

Courtesy of the John Deere and Company

INTRODUCTION

Fuel injectors are precision parts which operate rapidly under conditions of intense heat and high pressure. For these reasons, fuel injectors commonly fail to operate properly. If they are not repaired, serious engine damage can result. Many times an injector fails because it is dirty, and a mechanic often can correct the problem by cleaning it. In this learning activity package you will learn how to clean and service a diesel fuel injector.

DIRECTIONS

Before you begin this learning activity package, be sure you have completed Learning Activity Package 31, BLEEDING THE DIESEL FUEL SYSTEM.

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 6 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given a Roosa-Master tool set for service of nozzles, an injector nozzle popper, appropriate fittings, and the manufacturer's service manual, service a diesel fuel injector. All parts will fit correctly; there will be no leaks, and the nozzle will operate at pressure specified in the manufacturer's service manual.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), Chapter 5, pp. 29-33.

(or) _____

2 VIEW slides 1-20, "Removing Diesel Injection Nozzles"; slides 1-29, "Servicing Diesel Injection Nozzles"; and slides 1-24, "Testing Diesel Injection Nozzles" (Vocational Agriculture Service, University of Illinois).

(or) _____

3 CHECK YOUR KNOWLEDGE of diesel injectors by taking Student Self-Check, UNDERSTANDING DIESEL INJECTORS.

4 READ INSTRUCTIONS, SERVICING A DIESEL FUEL INJECTOR, and INSTRUCTIONS, TESTING NOZZLES.

(or) _____

5 STUDY the section on servicing a diesel fuel injector in the manufacturer's service manual for the designated tractor, or I & T Shop Manual.

(or) _____

6 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or) _____

7 PRACTICE servicing a diesel fuel injector for the designated tractor. Follow the procedure outlined in Learning Activity 4 and the manufacturer's service manual.

8 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 6.

TOOLS AND EQUIPMENT NEEDED

1. Roosa-Master Tool Set
2. Injector Nozzle Tester
3. Mechanic's Tool Set
4. Valve Tip Scraper

MATERIALS AND SUPPLIES NEEDED

1. Brass Wire Brush
2. Lapping Compound
3. Clean Diesel Fuel

SAFETY

Use Caution With High-Pressure Nozzle Tester.

INSTRUCTIONS

A. SERVICING A DIESEL FUEL INJECTOR

In servicing a diesel fuel injector, the following procedure should be used:

1. Remove faulty injector from engine.
2. Clean unit in pure diesel fuel.
3. Remove carbon dam seal and sealing washer.
4. Remove carbon from tip with brass wire brush.
5. Insert nozzle in holding fixture and place in vise.
6. Loosen lock nut and remove pressure adjusting screw, washer, and spring.
7. Remove nozzle valve from body. If nut came out easily, use retractor tool No. 16481. (Never mix nozzle bodies and valves. Keep in matched sets.)
8. Clean slip opening with 0.008 (.2032 mm) cleaning needle in pin vise. Clean up to size of opening. [You may have to start with .003 (.0762 mm) or .004 (.1016 mm) and work up to desired size.]
9. Clean seat with valve tip scraper.
10. Use sac hole drill to remove carbon from sac hole.
11. Polish guide to body. If necessary, use a light amount of Roosa-Master No. 16489 lapping compound.
12. Clean lapping compound out completely and reassemble nozzle. Back out lift-adjusting screw several turns to prevent bottoming during reassembly.
13. Install on a nozzle tester to set opening pressure, pattern, and leak off. (Important: When testing nozzle, do not let skin come in contact with spray from nozzle. It has sufficient pressure to puncture skin and cause blood poisoning.)
14. Check manufacturer's specifications for correct opening pressure, leak off, and other requirements.
15. Operate the tester to remove all air, and pump the lever at about 60 strokes per minute.
16. Observe spray pattern and nozzle sound. (There should be no long streaks of fuel on holes, and the nozzle should give a distinctive chatter to the valve closes.)
17. Pump the lever until the nozzle just begins to open and note the pressure.
18. Turn adjusting screw in and out until correct opening pressure is obtained.
19. Turn valve-lift adjusting screw until it just begins to bottom and then back out until the correct nozzle lift is obtained.

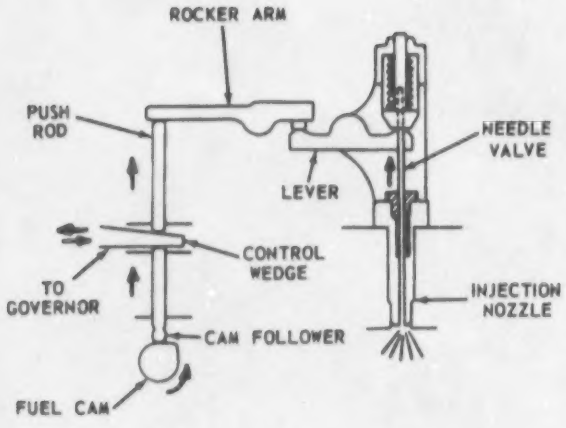


Figure 1. Common Rail Injection System

Courtesy of John Deere and Company

20. Lock down nozzle nut to correct torque.

21. Check for seat leakage by bringing the nozzle up approximately 1500 PSI (103.43 bars) and observing if fuel is leaking from tip of nozzle.

22. Raise pressure to 2400 PSI (165.48 bars) and observe seat. (Moisture is acceptable but no drop should form in 10 seconds.)

23. Tilt the nozzle tip above horizontal and bring pressure up to 1500 PSI (103.43 bars). (CAUTION: Be careful not to cause nozzle to operate at this time. Fluid could be injected into the skin or eye.) Observe top end of nozzle and see if leakage is within specifications for the time.

24. Install new carbon dam seals and top seals with appropriate tool.

25. Reinstall nozzle into system if all checks are correct. Bleed system and start engine.

INSTRUCTIONS

B. TESTING NOZZLES

In preparing the test stand for the injector test, the following procedure should be used:

1. Fill the test stand fuel reservoir.
2. Loosen the bleeder screw.
3. Once the fuel flowing from the bleeder screw opening is free of air bubbles, tighten the screw.
4. Wash the connector tube and adapter in clean diesel fuel.
5. Blow clean with compressed air.
6. Connect securely to the test stand.
7. Operate the hand lever slowly until clean fuel flows from the adapter.
8. The tester is ready for use.

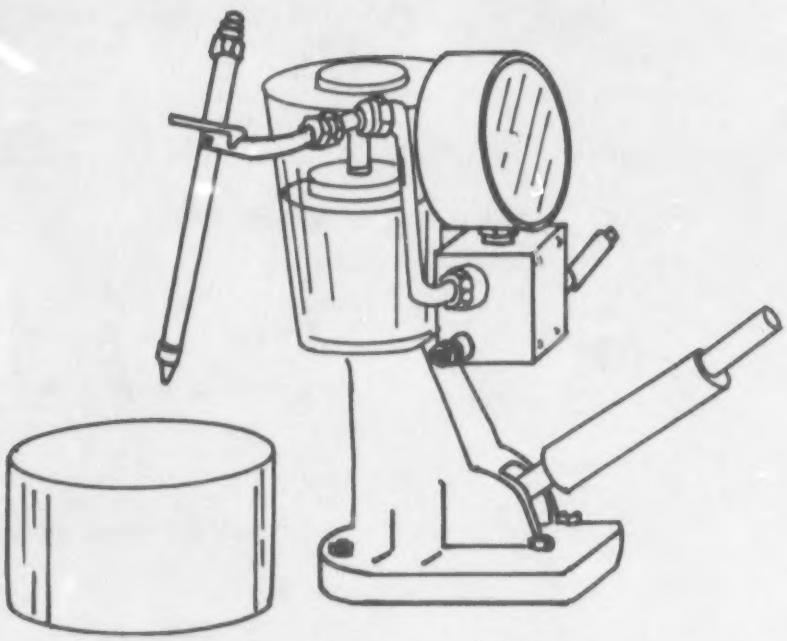


Figure 2. Nozzle Tester

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In preparing the injector for testing, the following procedure should be used:

1. Remove the loose carbon from the tip of the injector with a clean BRASS WIRE BRUSH.

2. Clean the carbon seal groove and body below the groove in the same manner. (NOTE: Do not brush the teflon coating above the carbon seal groove.)

3. Using the correct test pump adapter (check your manufacturer's service manual), connect the injector with the tip facing downward. (CAUTION: The injector tip should always be directed away from the operator. The fuel is under extremely high pressure and can penetrate the skin.)

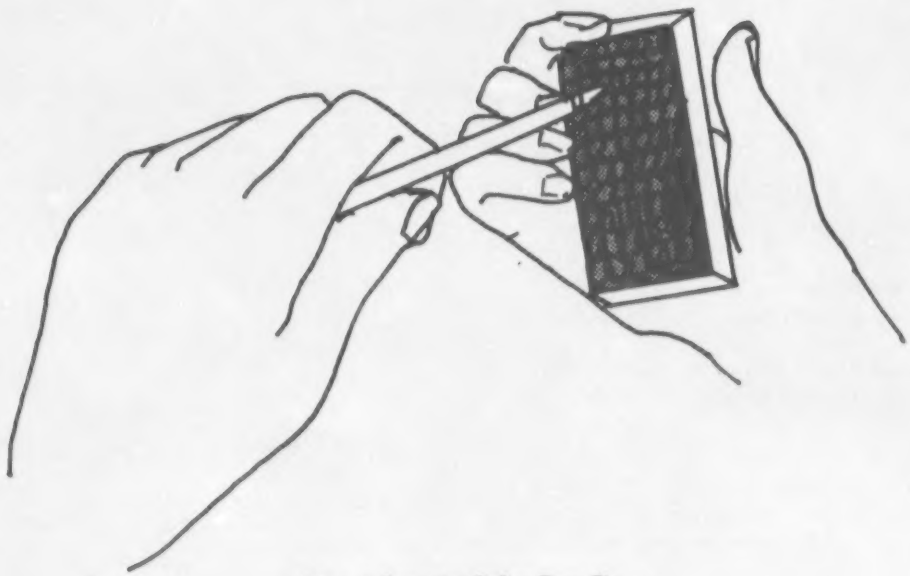

Figure 3. Removing Carbon From Tip

STUDENT SELF-CHECK
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UNDERSTANDING DIESEL INJECTORS

Answer the following:

1. What are the three functions of the injection nozzle?

2. Match the choices on the right with the two types of nozzles listed on the left.

Type of Injector	Choices
	Pintle
a) Inward opening	Hole
b) Outward opening	Differential pressure
	Multiple orifice
	Pintaux
	Poppet

3. List three things we use nozzles for:

4. What kind of brush should you use to clean the nozzles?

5. Injection nozzles use _____ pressure to oppose _____ pressure.

6. It is correct to mix nozzle parts if they are of the exact same type. (T or F)

Compare your answers with the correct responses at the bottom of this page. Review any questions you answered incorrectly before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A DIESEL FUEL INJECTOR.

In the shop area, service a faulty nozzle and make it work correctly.

CORRECT RESPONSES

1. a) Atomize the fuel
   b) Spread the fuel spray to fully mix it with air
   c) Inject fuel equally in all cylinders
2. a) Differential, Hole, Pintle, Pintaux
   b) Poppet, Pintle, Multi-orifice.
3. a) Chatter and spray pattern
   b) Opening pressure
   c) Valve leakage
4. Brass
5. a) Spring b) Fuel
6. False

DO NOT WRITE ON THIS PAGE

LAP TM–30

Student _____

Date _____

SERVICING A DIESEL FUEL INJECTOR

Instructor's Final Checklist

Check the student's performance in the following elements of servicing a diesel fuel injector.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In servicing the fuel injector, the student:				
1. cleaned the injector body in diesel fuel after removal from the engine	[ ]	[ ]	[ ]	[ ]
2. removed the carbon from the tip with a brass wire brush	[ ]	[ ]	[ ]	[ ]
3. disassembled nozzles without damaging parts	[ ]	[ ]	[ ]	[ ]
4. kept nozzle bodies and valves matched for the individual injector	[ ]	[ ]	[ ]	[ ]
5. cleaned the slip opening, seat, and sac hole	[ ]	[ ]	[ ]	[ ]
6. polished the guide to the body	[ ]	[ ]	[ ]	[ ]
7. cleaned out the lapping compound completely and reassembled the nozzle	[ ]	[ ]	[ ]	[ ]
8. set opening pressure, pattern, and leak off according to the manufacturer's specifications	[ ]	[ ]	[ ]	[ ]
9. adjusted the spray patterns, opening pressure, and nozzle lift	[ ]	[ ]	[ ]	[ ]
10. torqued the lock nut	[ ]	[ ]	[ ]	[ ]
11. checked for seat leakage at 1500 PSI and 2400 PSI	[ ]	[ ]	[ ]	[ ]
12. installed new carbon dam seal and top seals	[ ]	[ ]	[ ]	[ ]

80

DO NOT WRITE ON THIS PAGE

LAP TM–30

Student _____

Date _____

SERVICING A DIESEL FUEL INJECTOR (Continued)

Instructor's Final Checklist

Check the student's performance in the following elements of servicing a diesel fuel injector.

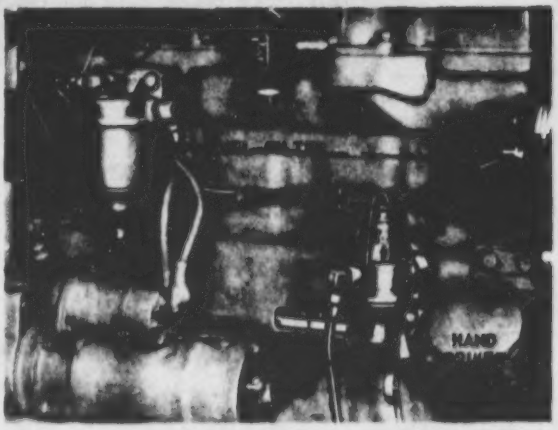
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
13. reinstalled the nozzle into the system	[ ]	[ ]	[ ]	[ ]
14. bled the system	[ ]	[ ]	[ ]	[ ]
15. checked operation of the engine	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 31

Objective 55



Courtesy of the John Deere and Company

Bleeding the Diesel Fuel System

Tractor Mechanics

INTRODUCTION

When a mechanic services the diesel fuel system, one job he must know how to do is bleed the system. Anytime the fuel system has been opened or let run without fuel, air will enter the system. If air is left in the system it may form an air lock preventing fuel from getting into the injection pump. If the air is not drained out of the system it will cause engine to fail to start or misfire and lose power. In this learning activity package you will learn how to bleed the diesel fuel system.

DIRECTIONS

Read the objective below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need to complete learning activities in order to be able to do the task, turn to p. 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using the designated tractor, the manufacturer's service manual, suitable wrenches, and diesel fuel, bleed a diesel fuel system. The fuel system will be bled in such a way as to remove all air from the lines. There will be no damage to any parts and the engine will start again.

LEARNING ACTIVITIES

1 READ *Fundamentals of Machine Operation: Preventive Maintenance*, pp. 50-51.

(or) _____

2 READ INSTRUCTIONS, BLEEDING THE DIESEL FUEL SYSTEM.

(or) _____

3 STUDY the section on bleeding the air from diesel fuel systems in the manufacturer's service manual for the designated tractor, or I & T Shop Manual for designated tractor.

(or) _____

4 CHECK YOUR KNOWLEDGE of bleeding a diesel fuel system by taking Student Self-Check, BLEEDING A DIESEL FUEL SYSTEM.

5 VIEW the slide-tape presentation, "Bleeding the Diesel Fuel System."

(or) _____

6 OBSERVE another student as he or she satisfactorily performs and is checked out on this Learning Activity Package.

(or) _____

7 PRACTICE bleeding air from the diesel fuel system on the designated tractor. Follow the procedure outlined on Instructions, BLEEDING THE DIESEL FUEL SYSTEM.

8 ARRANGE with your instructor to complete this Learning Activity Package by going through the CHECK-OUT ACTIVITY on page 4.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Manufacturer's Operator's Manual
3. I & T Shop Manual for Designated Tractor
4. Air Hose

SUPPLIES AND MATERIALS NEEDED

1. Clean fuel in tank
2. Clean rags & brush
3. Clean solvent for cleaning lines and injector

JOB SAFETY

Make sure that spilled fuel is cleaned up from tractor and shop floor.

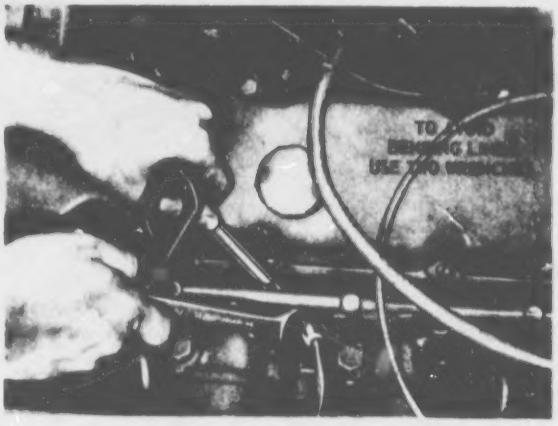


Figure 1. Bleeding Fuel Lines

Courtesy of John Deere and Company

INSTRUCTIONS

BLEEDING THE DIESEL FUEL SYSTEM

In bleeding the diesel fuel system the following procedure should be used:

1. Check the manufacturer's service manual for each individual system's recommended bleeding order.
2. Check to make sure there is clean fuel in fuel tank.
3. Turn on fuel cut-off at tank.
4. Loosen bleed plugs at primary fuel filter.
5. Activate manual fuel pump lever on priming pump until clean fuel flows from filter.
6. Close primary bleed plug and open secondary fuel filter bleed plug.
7. Activate fuel pump lever on priming pump until clean fuel comes from secondary filter.
8. Close bleed plug and continue to operate fuel pump for 10-12 strokes.
9. Take appropriate wrenches and loosen injector high pressure lines at nozzle.
10. Turn engine over until fuel with no air bubbles comes out at connection.
11. Tighten lines and repeat procedure until all nozzle lines are bled.
12. Turn engine over and start.
13. If engine fails to start, repeat procedure to remove air left from first bleeding. If it still won't start, check for other possible causes of fuel problem. (See manufacturer's service manual.)

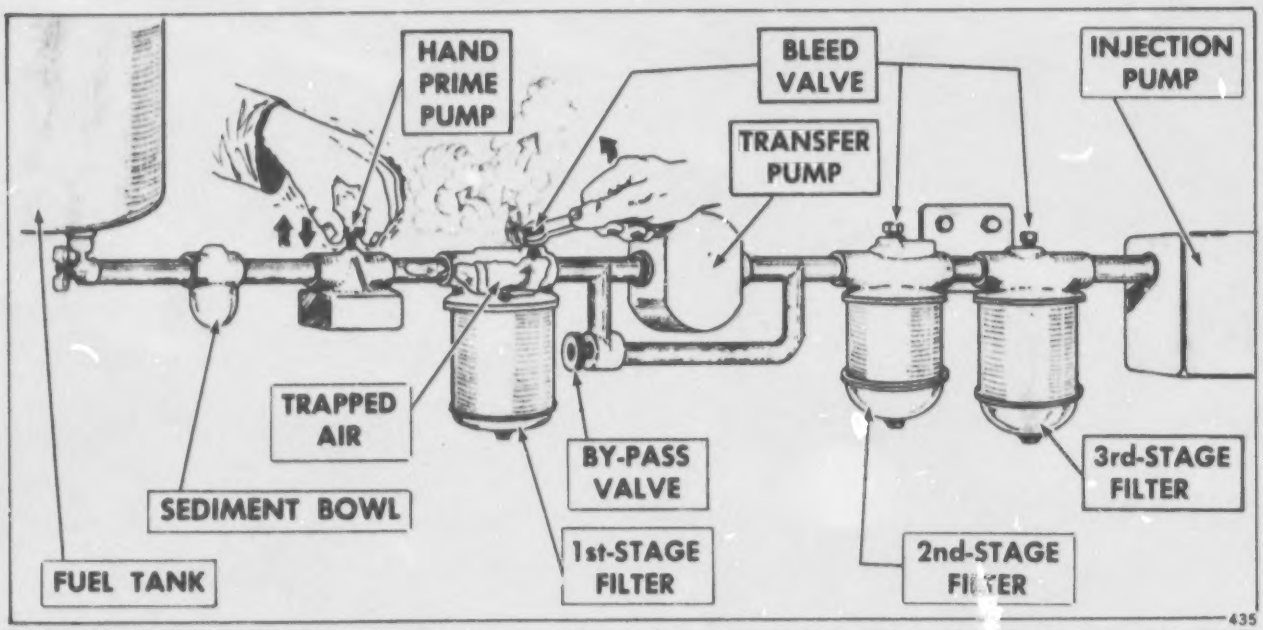


FIGURE 2. Bleeding the first-stage filter. When a filter element is changed, air is trapped in the filter body and adjacent feed lines. This is bled off by opening the bleed valve, allowing air to escape and fuel to replace it. A hand-prime pump is used on some tractors to help force fuel through the system. Transfer pumps are usually equipped with a bypass line which is used for priming purposes. Most pumps block passage of fuel except when operating. The bypass valve is kept closed except during bleeding of second- and third-stage filters.

Courtesy of the American Association for Vocational Instructional Materials

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
BLEEDING A DIESEL FUEL SYSTEM

Complete the following:

1. Why is it necessary to bleed a diesel engine?

2. In the space below, diagram the fuel system for the designated tractor. Show all parts and lines. Number each part in the sequence which you would use to bleed the system.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, BLEEDING THE DIESEL FUEL SYSTEM.

Bleed the diesel fuel system on the designated tractor.

CORRECT RESPONSES

1. To remove trapped air which would cause the engine to run rough or fail to start.
2. Check the references in Learning Activities 1-3.

DO NOT WRITE ON THIS PAGE

LAP TM–31

Student _____

Date _____

BLEEDING THE DIESEL FUEL SYSTEM

Instructor's Final Checklist

Check the student's performance in the following elements of bleeding the diesel fuel system.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	In bleeding the diesel fuel system, the student:				
a.	checked the manufacturer's service manual for the recommended bleeding order	[ ]	[ ]	[ ]	[ ]
b.	checked fuel tank for ample fuel	[ ]	[ ]	[ ]	[ ]
c.	turned on the fuel cut-off at the tank	[ ]	[ ]	[ ]	[ ]
d.	loosened the bleed plugs at the primary fuel filter	[ ]	[ ]	[ ]	[ ]
e.	activated the manual fuel pump lever on the priming pump until clean fuel flowed from the filter	[ ]	[ ]	[ ]	[ ]
f.	closed the primary bleed plug	[ ]	[ ]	[ ]	[ ]
g.	opened the secondary fuel filter bleed plug	[ ]	[ ]	[ ]	[ ]
h.	activated the manual fuel pump lever on the priming pump until clean fuel came from the secondary filter	[ ]	[ ]	[ ]	[ ]
i.	closed the bleed plug	[ ]	[ ]	[ ]	[ ]
j.	continued operating the fuel pump for 10–12 more strokes	[ ]	[ ]	[ ]	[ ]
k.	took wrenches and loosened the injector high pressure lines at the nozzle	[ ]	[ ]	[ ]	[ ]

DO NOT WRITE ON THIS PAGE

LAP TM–31

Student _____

Date _____

BLEEDING THE DIESEL FUEL SYSTEM (Cont'd)

Instructor's Final Checklist

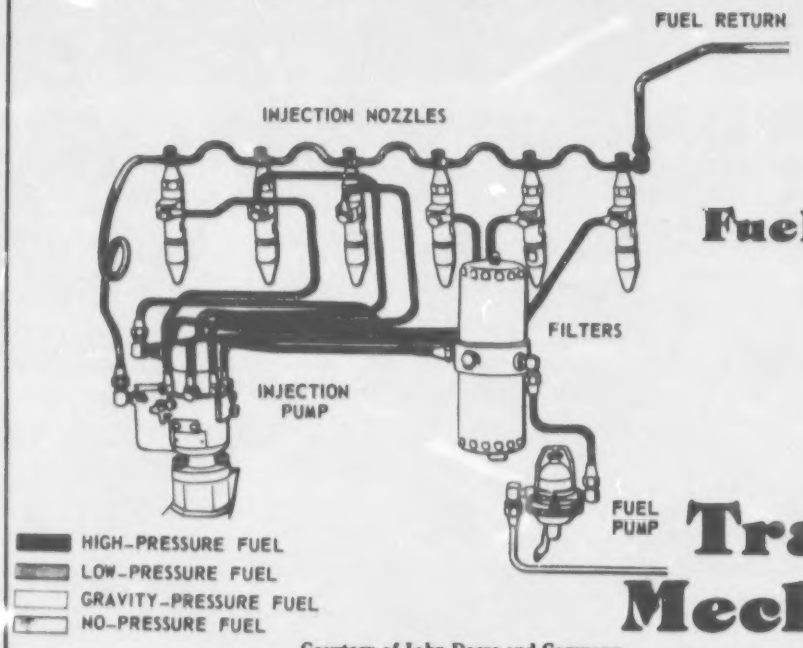
Check the student's performance in the following elements of bleeding the diesel fuel system.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
l.	turned the engine over until fuel with no air came out at the connection	[ ]	[ ]	[ ]	[ ]
m.	tightened the lines	[ ]	[ ]	[ ]	[ ]
n.	repeated this procedure until all nozzle lines were bled	[ ]	[ ]	[ ]	[ ]
2.	After having the fuel lines bled:				
a.	the tractor started	[ ]	[ ]	[ ]	[ ]
b.	the engine ran smoothly	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 32



Courtesy of John Deere and Company

Objective no. 91

Timing A Fuel Injection Pump

Tractor Mechanics

INTRODUCTION

Many of the diesel tractors a mechanic services will need to have the fuel injection pump checked for correct timing. If the fuel injection pump is not properly timed, the engine will misfire and lose power. But if the injection pump is timed accurately, the engine will operate with maximum horsepower. In this Learning Activity Package you will learn how to time a fuel injection pump.

DIRECTIONS

Before you start to work on this Learning Activity Package, be sure you have completed Learning Activity Package 29, "Servicing a Diesel Injection Pump," and Learning Activity Package 31, "Bleeding the Diesel Fuel System."

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to p. 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given a tractor engine, necessary wrenches, and the manufacturer's service manual, time the fuel injector pump on the engine. The reinstalled pump will be timed to within one half of a degree of the specifications given in the manufacturer's service manual.

LEARNING ACTIVITIES

1 READ INSTRUCTIONS, TIMING A FUEL INJECTION PUMP.

(or) _____

2 STUDY the section on timing the fuel injection pump in the manufacturer's service manual for the designated tractor, or study the I & T Shop Manual for tractor being serviced.

(or) _____

3 CHECK YOUR KNOWLEDGE by taking student Self-Check, TIMING A FUEL INJECTION PUMP.

(or) _____

4 OBSERVE another student as he or she satisfactorily performs and is checked out on this module.

(or) _____

5 PRACTICE timing a fuel injection pump on the designated tractor. Follow the procedure outlined in the manufacturer's service manual and/or Learning Activity 1.

6 ARRANGE with your instructor to complete this module by going through the CHECK-OUT ACTIVITY on page 4.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Remote Starter Control (for cranking engine)
3. Manufacturer's Service Manual or I & T Shop Manual

SUPPLIES AND MATERIALS NEEDED

1. Cleaning solvent and container
2. Brush
3. Clean rags
4. New gasket for timing window cover

SAFETY

No special safety precaution necessary

INSTRUCTIONS

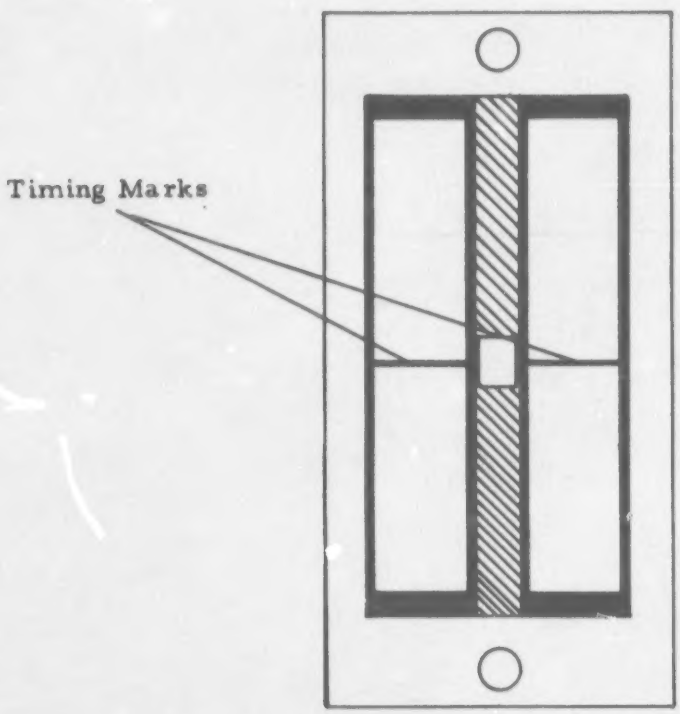
TIMING A FUEL INJECTION PUMP

In timing a fuel injection pump, the following procedure should be used:

1. Check manufacturer's specification for timing the make and model of the designated tractor. (Information below is for a Roosa-Master fuel injection pump.)
2. Shut off the fuel supply valve.
3. Remove timing window cover from injection pump.
4. Remove No. 1 injector and make sure cylinder is on the compression stroke.
5. Rotate the engine slowly until the manufacturer's recommendation for the timing mark on the engine flywheel aligns with the timing pointer. (The timing lines in the injection pump timing window should be exactly aligned as shown in the drawing below.)

If pumping lines are not in register as shown, proceed with the following:

1. Loosen the pump mounting stud nuts.
2. Turn pump as required to bring lines into register.
3. Tighten mounting stud nuts securely.
4. Recheck your setting by turning the engine two complete revolutions forward.
5. Recheck the timing marks. (They should match the manufacturer's recommendations.)



STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
TIMING A FUEL INJECTION PUMP

1. If the fuel injection pump is not properly timed, the engine will _____ and _____.

2. If the timing marks are 1/4 inch (approximately 63 mm) apart, the engine is adequately tuned. (True or False)

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, TIMING A FUEL INJECTION PUMP.

Time a fuel injection pump on the designated tractor engine.

CORRECT RESPONSES

1. Misfire, lose power
2. False

DO NOT WRITE ON THIS PAGE

LAP TM–32

Student _____

Date _____

TIMING A FUEL INJECTION PUMP

Instructor's Final Checklist

Check the student's performance in the following elements of timing a fuel injection pump.

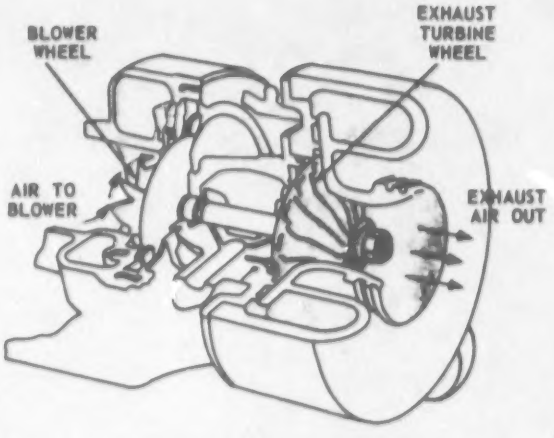
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	While timing a fuel injection pump, the student:				
	a. checked the manufacturer's specifications	[ ]	[ ]	[ ]	[ ]
	b. shut off the fuel supply valve	[ ]	[ ]	[ ]	[ ]
	c. removed timing window cover	[ ]	[ ]	[ ]	[ ]
	d. brought the piston up on the compression stroke with the No. 1 injector removed	[ ]	[ ]	[ ]	[ ]
	e. rotated the engine to match the timing marks	[ ]	[ ]	[ ]	[ ]
2.	If the timing marks did not match, the student:				
	a. loosened the pump	[ ]	[ ]	[ ]	[ ]
	b. turned the pump to match the marks	[ ]	[ ]	[ ]	[ ]
	c. tightened the bolts	[ ]	[ ]	[ ]	[ ]
	d. rechecked the timing after turning the engine over	[ ]	[ ]	[ ]	[ ]
3.	The timed fuel injector pump:				
	a. was timed within one-half of a degree of the specifications given in the manufacturer's service manual	[ ]	[ ]	[ ]	[ ]
	b. caused the engine to run smoothly	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 33

Objective no. 90



Courtesy of the John Deere and Company

Servicing A Turbocharger

Tractor Mechanics

INTRODUCTION

Many of the larger tractors that will come into the shop will have a turbocharger needing service. The turbocharger gives the engine a higher compression ratio than it would normally have. If the bearings or impeller becomes damaged, it could cause drag to the engine and result in loss of horsepower and excessive smoking. In this Learning Activity Package you will learn how to properly service a turbocharger.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 5 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, turn to p. 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using the designated tractor, the manufacturer's service manual, a set of mechanic's tools, a gasket scraper, torque wrench, and a dial indicator with plunger extension, service a turbocharger. Replaced or reinstalled unit should meet the manufacturer's specifications and all points of the instructor's checklist.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), Chapter 6, pp. 14-16 and 20-22.

(or)

2 CHECK YOUR KNOWLEDGE of turbochargers by taking Student Self-Check, SERVICING A TURBOCHARGER.

(or)

3 READ INSTRUCTIONS, SERVICING A TURBOCHARGER.

(or)

4 STUDY the section on servicing a turbocharger in the manufacturer's service manual for the designated tractor.

(or)

5 OBSERVE another student as he or she satisfactorily performs and is checked out on this learning activity package.

(or)

6 PRACTICE servicing a turbocharger on the designated tractor. Follow the procedure outlined in Learning Activity 3 and the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 5.

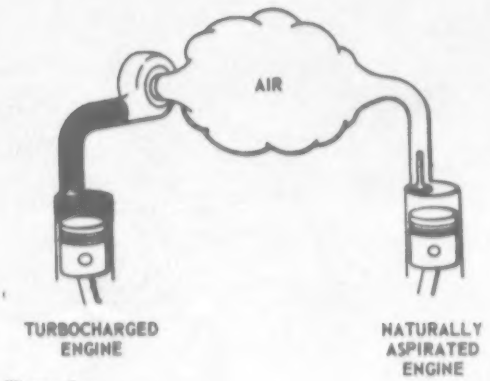


Figure 1

Courtesy of John Deere and Company

TOOLS AND EQUIPMENT NEEDED

Mechanic's Tool Set
Gasket Scraper
Torque Wrench
Dial Indicator with Plunger Extension

SUPPLIES AND MATERIALS NEEDED

None

SAFETY

No special precautions

INSTRUCTIONS

SERVICING A TURBOCHARGER

In servicing the turbocharger, the following procedure should be used:

1. Clean area to eliminate possibility of dirt entering the lubricating system for the turbocharger.
2. Remove air intake lines from turbocharger.
3. Remove adapter, air lines, exhaust elbow and other loose connections.
4. Unbolt turbocharger and remove from exhaust manifold.
5. Clean manifold completely of old gasket.
6. Inspect the blades of the turbocharger through the housing and end openings. (Blades should not be bent or broken as this causes problems in balance.)
7. Using a dial indicator with plunger extension, check radial bearing play through air outlet port while moving both ends of turbine shaft equally.
8. Check shaft end-play with dial indicator. If side- or end-play exceeds manufacturer's specifications, replace the unit.
9. Install new gaskets and replace the turbocharger to exhaust manifold. Torque to desired tightness.

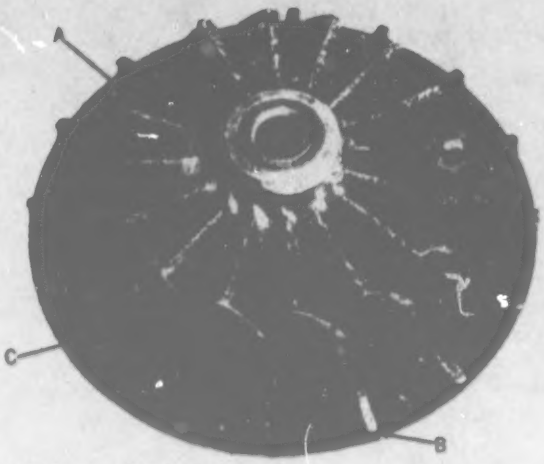


Figure 2 – Damaged Impeller

Courtesy of John Deere and Company

10. Reinstall air lines, outlet lines, and adapter between turbocharger and exhaust elbow. Make sure parts are aligned perfectly and that adapter rotates freely and has at least 1/16 inch (1.587 mm) free play.
11. Put air lines back to turbocharger and check all connections for tightness. (Note: Never start a reworked turbocharger until there is engine oil in the turbocharger bearing.)
12. Pull the engine stop and turn engine over until the oil pressure gauge shows in the working range.
13. Start engine and let run at 1000 RPM for 5 minutes to make sure bearing is well lubricated before pulling at high idle.

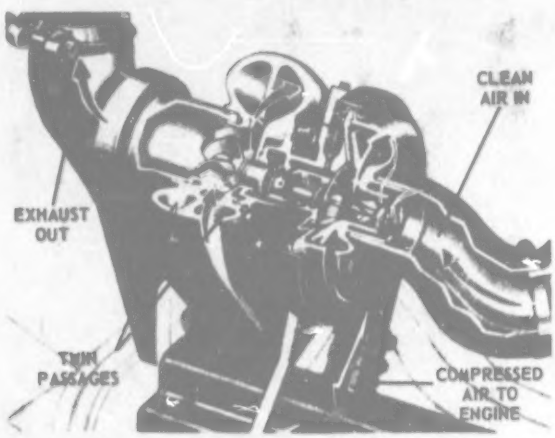


Figure 3 – Turbocharger on a modern engine

Courtesy of John Deere and Company

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
SERVICING A TURBOCHARGER

Answer the following:

1. A turbocharger is a type of centrifugal supercharge. (T or F)

2. A turbocharger is an exhaust-driven turbine which drives a compression wheel. (T or F)

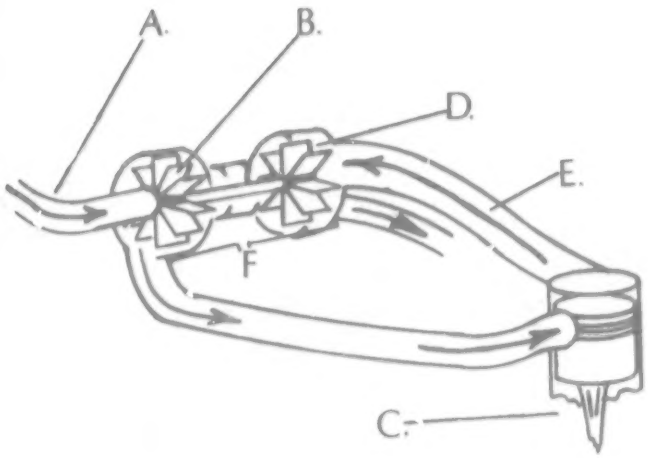
3. What is the major job of the turbocharger?

4. The of the turbocharge is located between the air cleaner and the intake manifold, while the is located between the exhaust manifold and the muffler.

5. The turbocharger is onsidered to be an effective spark arrester. (T or F)

6. Label the following sketch:

Figure 2. A Distributor Injection Pump in Cutaway View



Courtesy of John Deere and Company

7. Name 5 advantages of using a turbocharger.

   a.
   b.
   c.
   d.
   e.

8. What special actions must be taken if an engine with a turbocharger in it stalls?

9. A whine heard during shut-down of a turbocharger indicates bearing failure. (T or F)

10. Which of the following is NOT a recommended point for periodic inspection?

    a. Turbocharger mountings and connections (for oil leakage)
    b. Engine crankcase (for restricted oil flow)
    c. Air cleaner (serviced if dirty)
    d. Turbocharger in operation (for vibration)
    e. Engine under load (for excess smoke)
    f. Engine at rated RPM (for unusual noise)
    g. Turbocharger bearings (grease zerks regularly)

Compare your answers with the correct responses on the next page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. True
2. True
3. Force more air into the engine cylinder
4. Compressor, turbine
5. True
6. a. fresh air intake
   b. compressor
   c. cylinder
   d. turbocharger
   e. exhaust gases
   f. turbine
7. a. increase horsepower
   b. reduce weight
   c. reduce cost
   d. more power at high altitude
   e. reduce smoke
8. Restart immediately
9. False
10. g

CHECK–OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A TURBOCHARGER.

Replace or reinstall the turbocharger on the designated tractor.

DO NOT WRITE ON THIS PAGE

LAP TM-33

Student _____

Date _____

SERVICING A TURBOCHARGER

Instructor's Final Checklist

Check the student's performance in the following elements of servicing a turbocharger.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In servicing the turbocharger, the student:				
a. cleaned area around turbocharger	[ ]	[ ]	[ ]	[ ]
b. removed the air intake lines from the turbocharger	[ ]	[ ]	[ ]	[ ]
c. removed the adapter, air lines, exhaust elbow and other loose connections	[ ]	[ ]	[ ]	[ ]
d. unbolted the turbocharger and removed it from the exhaust manifold.	[ ]	[ ]	[ ]	[ ]
e. cleaned the manifold completely of the old gasket	[ ]	[ ]	[ ]	[ ]
f. inspected the blades of the turbocharger through the housing and end openings	[ ]	[ ]	[ ]	[ ]
g. checked the radial bearing play through the air outlet port while moving both ends of the turbine shaft equally	[ ]	[ ]	[ ]	[ ]
h. checked the shaft end-play with a dial indicator	[ ]	[ ]	[ ]	[ ]
i. compared the reading with the manufacturer's service manual	[ ]	[ ]	[ ]	[ ]
j. installed a new gasket when replacing the turbocharger to the exhaust manifold	[ ]	[ ]	[ ]	[ ]
k. torqued to the desired tightness	[ ]	[ ]	[ ]	[ ]

DO NOT WRITE ON THIS PAGE

LAP TM-33

Student _____

Date _____

SERVICING A TURBOCHARGER (cont'd.)

Instructor's Final Checklist

Check the student's performance in the following elements of servicing a turbocharger.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
l.	reinstalled the air lines, outlet lines, and adapter between the turbocharger and the exhaust elbow	[ ]	[ ]	[ ]	[ ]
m.	checked all air lines for tightness	[ ]	[ ]	[ ]	[ ]
n.	pulled the engine stop and turned the engine over until the oil pressure gauge showed a working range of oil pressure	[ ]	[ ]	[ ]	[ ]
2.	The turbocharger, after being serviced by the student:				
a.	rotated freely	[ ]	[ ]	[ ]	[ ]
b.	had at least 1/16" of free play	[ ]	[ ]	[ ]	[ ]
c.	had no noisy operation or vibration	[ ]	[ ]	[ ]	[ ]